IFOMC

9th International Fisheries Observer and Monitoring Conference

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Proceedings of the 9th International Fisheries Observer and Monitoring Conference

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Acknowledgements

We would like to express our deepest appreciation to all those who participated in and supported the 9th International Fisheries Observer and Monitoring Conference. In particular we acknowledge the Conference Organising Committee, whose contributions over many months led to a very successful conference that resulted in tangible outcomes for the well-being of observers and the ongoing monitoring of fisheries throughout the world.

We thank especially our main hosts, Marine Instruments who funded a great deal of the conference and supplied all kinds of additional assistance and staff before, during and after the event.

Our conference GOLD sponsors NOAA Fisheries and Marine Instruments deserve special mention for assisting the event financially and providing a great deal of display material and other support. Our SILVER sponsor DTU Aqua also contributed significant funding for the event. And our BRONZE sponsors WWF, AZTI Tecnalia, ISSF, ATUNLO, Coper also contributed significantly. Xunta de Galicia and Concello de Vigo sponsored events at the conference whilst the EFCA was a supporter of the conference and Pescachile was an observer sponsor.

In addition, our exhibitors, Marine Instruments, Archipelago Marine Research, NOAA Fisheries, Anchor Lab, AIS Inc, Integrated Monitoring, Marel Food Systems and Satlink not only assisted the conference financially but provided an array of fantastic technical backdrops to the event with many varied and cutting edge displays of their latest equipment, software and other materials.

We would also like to thank Peta Kennelly (IC Independent Consulting) for her painstaking work assisting us with the compilation of these Proceedings.

But the greatest thanks must go to our delegates. Your collective experiences and expertise that was on display in the oral and poster sessions, the three workshops and the many discussion periods supplied the main intellectual substance of the conference and, as a result, these proceedings.

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Exhibitors

The 9th IFOMC International Steering Committee

The Steering Committee for the Conference was fundamental to the success of the event, organising many aspects of the meeting as well as individually taking charge of the 11 themes and 3 workshops that ran throughout the meeting. The Steering Committee members were:

Lisa Borges (Committee Chair), FishFix, Belgium

Gabriel Gomez (Conference Chair), Marine Instruments, Spain

Steve Kennelly, IC Independent Consulting, Australia

Howard McElderry, Archipelago Marine Research Ltd., Canada

Judy Dwyer, Fisheries and Oceans, Canada

Andrew France, Ministry for Primary Industries, New Zealand

Luis Cocas González, Ministry of Fisheries, Chile

Jørgen Dalskov, DTU Aqua, Denmark

Elizabeth Chilton, NOAA/NMFS, USA

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Jennifer Mondragon, NOAA/NMFS, USA

Amy Martins, NOAA/NMFS, USA

Elizabeth Scott-Denton, NOAA/NMFS, USA.

John LaFargue, NOAA/NMFS, USA.

Executive Summary

The 9th International Fisheries Observer & Monitoring Conference took place in the Hotel Pazo de los Escudos, Vigo, Spain from 11th to 15th June, 2018.

The overarching Vision of this series of conferences is: To develop, promote and enhance effective fishery monitoring programs to ensure sustainable resource management throughout the world.

The conference was the most successful of the series so far involving 279 participants from 39 countries including representatives from many observer programs from around the world, fishing industry groups, and end-users of the data that these programs collect. The conference format included three distinguished keynote speakers, presented papers and posters, panel discussion sessions, workshops and less formal settings, such as trade exhibits, poster sessions and several social events.

As for previous conferences, the heart of this conference was with our observers who have what is becoming accepted as one of the most challenging and dangerous jobs in natural resource management. Indeed, this conference series always devotes significant time and energy discussing ways to enhance observer safety and security through training, policing and legislation.

As for recent conferences, the Vigo meeting had a major focus on the growing role that technology is playing in the monitoring of fisheries, through video, satellite and other high-tech means.

But the most important and major theme at this, our first European conference, concerned the European Union's Landing Obligation policy and its consequences, challenges and opportunities for monitoring programs involving human observers and electronic means.

The conference consisted of 11 themes that were reflected in the various keynote addresses, oral and poster presentations, workshops and the many Open Discussion periods. The following pages provide significant detail about all these various formats in the form of summaries of each presentation, the 3 workshops and commentaries obtained during the Open Discussion periods.

Opening Session – Keynote Addresses

The opening session of the 9th IFOMC began with the Conference Chair, Gabriel Gomez, International Steering Committee Chair, Lisa Borges and Head of the Fisheries Department of the Regional Government of Galicia, Rosa Quintana Carballo delivering addresses that welcomed participants to Spain, Galicia and Vigo, and introduced the themes and format of the conference.

These welcomes were followed by three keynote addresses by: Cornelius Hammer (President of ICES), Pascal Savouret (Executive Director of the European Fisheries Agency) and Francesca Arena (Head of Fisheries Control and Inspections at DG MARE). The former two provided Extended Abstracts of their addresses.

Observer and Observer Data – What for? – A view from an ICES perspective

Cornelius Hammer

President of ICES

The sea and the oceans are enormously wide, deep and non-transparent. That is trivial – too trivial to mention, one might think. Too trivial for sure to make an introduction to a keynote lecture. It is however important to realize that we, in our limitations as human beings, are not able to grasp the dimensions of width, depth and in-transparency. This is due to our incapability to image great quantities. We have an inner concept for 10.000 Euro. We can also image what 100.000 Euro are. If one is lucky also of a million, due to fortune experience. We can however not image 100 million or a billion. The same holds for the sea. We have all experienced days and weeks on sea but still we cannot image how wide and deep and non-transparent it really is.

As a result of the width, depth and non-transparency, there are fundamental differences between the exploitation of the resources at land and on sea. On land we have direct methods to evaluate what we are dealing with. We can go into the woods and measure and count the trees. We can go into the stable and count the piglets. Not so on sea. Here things are less straight forward. Whatever we do, it will be an indirect approach. Our best surveys have tracks that are still miles apart from each other and our sampling is stochastic. On top of it, our objects move and in morning they won't be there where we had encountered them the evening before. Naturally, our approach to assess this is statistically and inevitably we end up with huge confidence intervals that can only be made smaller by more and better data, which we desperately need.

This is where the observers come in. The data we deal with stem either directly from the fishing industry, that is what is recorded during landing of the fish, from observers taking subsamples and providing more detailed data or from fishery research vessels. The former provides about 70% of our data while the latter comes up for the rest, which sheds a light on the importance of the industry and observer data.

In ICES the data of the fishery constitute of the different metiers from different nations, each nation having a different suit of metiers, naturally, and basically from each metier ICES receives data of both, the catch as well as the discard. The latter however, we have only because observer on board collect these. This has helped considerably to improve our assessments. In the EU the work of the observers is hugely financed by the European Data Collection Framework.

The data go into our assessments and are accomplished with data from our research vessels, which are mainly data on abundance, distribution and recruitment. From the assessment we derive at a perception of the development of the stocks and with the aid of the recruitment data we can make forecasts and are able to predict under which scenario of the fishery in combination with a particular Total Allowable Catch (TAC) the stocks will develop to what state. Our advice is strictly based on the precautionary principles and is submitted to the governments, who decide on TACs of the next year and end up as quotas for the fishery, closing the annual cycle. ICES gives advice annually for more than 100 stocks and this is an enormous service for the fishery.

The observer data play a key-role in this annual cycle and their importance can well be illustrated by two examples:

The development of the cod in the Irish Sea shows a dramatic decline, starting in the early 1990s and leading to a collapse of the stock in the first decade of the 2000 years, resulting in very weak recruitment. The stock has however recovered considerably since and is at present just at or above its safe biological limits. The observer data show that hardly any of the remaining stock as well as the upcoming year classes is fished, the fishing mortality has gone down to practically zero and as a consequence the stock was and is able to recover, based on the weak recruitment.

Not so for the neighbouring cod stock West of Scotland, that has shown a similar decline during the same period. This stock shows however no sign of recovery and will not be able to do so. The observer data show that all upcoming year classes that could in principle lead to stock recovery, are caught and discarded as unwanted by-catch in other fisheries.

The importance of the work of observer is also evident in other sectors, such as the recreational fishery. Here, all available data stem from the observers, who screen the coasts and little harbours to collect the data, in Europe massively supported financially by the EU. Due to this it could for instance be shown by ICES that within the past decade the recreational fishery has continuously grown and that the catch of the recreational fishery in the Western Baltic Sea has recently reached the same magnitude as the commercial fishery.

In a nutshell. Observers…

- provide detailed and disaggregated data on the catches of the fishery,
- provide detailed and disaggregated data on discards,
- provide data from exotic metiers, such as recreational fishery,
- can explain the data to the scientists on land. They can distinguish between sense and nonsense,
- are a link to the fishery. They understand (better) what is going on in the fishery and can explain the fleet behaviour,

- can explain (to some degree) how science can help to improve the conditions of the stocks and thus the fishing opportunities,
- can explain (to some degree) that regulations make sense,
- constitute an essential link between the fishery and the science.

For the future, also small metiers can be observed electronically. Small devices for mobile phones can make on-board recording easy and thus give the small scale fishery opportunities where otherwise closures would be categorically be imposed.

For the future it is also suggested that ICES provides courses for observers to facilitate them with better knowledge of what is going on in science and in the assessments as well as in the particular stocks they are sampling. This would give them a better foundation to provide explanations on board of the vessels and thus to constitute a better link between science and the fishery.

For the future the question may arise whether bird bycatches or collected benthos as well as plastics or other debris such as ghost nets need to be recorded by the observers.

In quintessence, it is concluded that the work of the observers is of utmost importance for ICES and that their importance is likely to grow. Better training should however be provided by ICES training courses.

European Fisheries Control Agency's summary for the Ninth International Fisheries

Observer and Monitoring Conference (IFOMC)

Pascal Savouret

Executive Director of the European Fisheries Agency

<u>Presenting EFCA</u>
The European Fisheries Control Agency (EFCA) objective is to organise operational coordination of fisheries control and inspection activities by the Member States and to assist them to cooperate to comply with the rules of the Common Fisheries Policy, in order to ensure its effective and uniform application. EFCA is one of the smallest European Agencies with today an Establishment Plan of 61 staff and a current annual budget of around 17 M€.

The main legal and operational instrument available is the Joint Deployment Plan (or JDP) which encompasses the pooling of control means, the planning, the tasking, the risk management strategy and, the analysis of the output. EFCA is currently cooperating with the Member States in the implementation of five Joint Deployment Plans and coordinates around 20,000 inspections per year.

Besides JDPs, EFCA:

- Supports the Regional Control Expert Groups set up by the Member States;

- Provides training and capacity building activities;
- Evaluates the compliance to the rules of selected European Fisheries;
- Supports the Union in the international dimension of the Common Fisheries Policy and the fight against Illegal, Unreported and unregulated (IUU) fishing;
- Can provide observers and train them for joint operations by the Member States concerned;
- In addition, cooperates with Frontex1 and EMSA2 to support the National Authorities delivering missions falling under the European Coast Guard function and operates its own Offshore Patrol Vessel.

Whilst fishing vessels usually do not attract a lot of attention, fishing activities are ubiquitous. In the recent past, IUU fishing activities have encompassed other illegal activities and/or major deficiencies related to vessel safety, illegal migration, other trafficking, smuggling, crew certification and labour standards. Here, there is a clear interconnection between the respective mandates of Frontex and EMSA and the National Authorities delivering Coast Guard functions.

In the international dimension of the Common Fisheries Policy, the European Union (EU) also participates in certain RFMO international control schemes by virtue of its membership of these organisations. EFCA supports the EU contribution to the control and inspection measures applicable in the Regulatory Areas managed by the Northwest Atlantic Fisheries Organisation (NAFO), the North East Atlantic Fisheries Commission (NEAFC), the International Commission for the Conservation of Atlantic Tunas (ICCAT), and the General Fisheries Council for the Mediterranean (GFCM). EFCA assists, in the framework of the project PESCAO, the Fisheries Committee for the West Central Gulf of Guinea (FCWC) and West African Sub-Regional Fisheries Commission (SRFC) in the establishment of a network of regional observers in a dedicated programme to improve the monitoring of the industrial fleet operating in the region in cooperation with national authorities.

<u>Inspection and observation</u>
Taking the opportunity of addressing the 9th International Fisheries Observer and Monitoring Conference (IFOMC), I would like to underline the constructive complementarity of the two facets of active monitoring of the fishing activities:

- Inspection and;
- Observation.

Compared to the continuous monitoring permitted by observation, the inspection is a snapshot. Indeed, the inspection process cannot be limited to the time spent on board the inspected vessel. The inspection spearheads the Monitoring, Control and Surveillance (MCS)

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1 European Border and Coast Guard Agency

2 European Maritime Safety Agency

loop, which encompasses the risk management strategy, the risk analysis, the targeting, the tasking of inspection assets, which can include landing or dockside inspection parties, the inspection itself, and finally the post-inspection analysis that will feed the risk management strategy. This is the starting point for reinitiating the enforcement loop.

At this stage, we have to admit that the inspection process, to some extent, has moved in recent years toward the observation process, through the continuous flow of visual, location and catch data parsed by the fishing vessels to the shore based Fisheries Monitoring Centre.

Moreover, innovative business intelligence applications provide a powerful tool for the analysis of the Monitoring Control and Surveillance (MCS) data, very likely to track and identify inconsistencies, which may later lead to evidencing non-compliance(s).

Understanding the drivers for non-compliance is a critical aspect of the risk management strategy because it encompasses the economic dimension of the fishing activities but also the level of deterrence that the enforcement and sanctions are likely to instil. The risk management strategy can offer solutions for mitigating the risk. An efficient MCS implementation plan combined with a dissuasive and proportionate sanction system applying to behaviour breaching the law is the conventional avenue for mitigating the risk of non-compliance.

<u>Observers` advantages and constraints</u>
Another avenue for mitigating the risk of non-compliance is observation. In fisheries where direct inspection and risk analysis throw doubts on the veracity of the catch and other obligatory information being reported by the fishing vessel, an option available to managers is to place a human observer on board the vessel.

The purpose of embarking the observer is to obtain an independent and near-continuous view of the following:

- The activities of the vessel;
- Volumes and compositions of catches made;
- Fishing gear deployed;
- Discards, bycatches and interactions with other marine animals;
- Compliance with the applicable rules in force.

The contribution of an observers` programme to the Monitoring, Control and Surveillance measures has:

Advantages	**Constraints and Considerations**
Information and data collected independently of the vessel; Knowledge, experience, adaptability; *In situ* logic and analytical capability (ability to assess a situation in real time).	Impartiality; Physical and technical support; Independent communication means; Training, skills and personality profiles; Coercion, threats and manipulation; Legal status and interactions with inspectors; Funding – human observers are expensive; Follow-up – how to use the data?

Nonetheless, an observers` programme can be undermined for the reasons already mentioned and mitigating solutions need to be considered.

Possible ways forward: e-Observer, RPAS, and Control Observer

The implementation and empowerment of the Control Observer of the article 73 of the EU Control Regulation offer significant advantages. An alternative and/or a complementarity to deploying a human observer is to use new technologies to make remote observations, termed Remote Electronic Monitoring (REM) or e-observer. Such an approach has inherent cost savings, but does not provide to now the real-time analytical role that a human observer can fulfil. REM systems trials in European fisheries by Denmark and the United Kingdom have shown considerable potential. Technical capabilities of REM systems, CCTV being only one of the components, to meet specific control requirements are steadily improving. The legal status of evidence derived from REM systems is still uncertain and Member States legislative provisions on REM are nascent.

REM systems as a direct control tool in European fisheries, other surveillance technologies such as Remote Piloted Aircraft System (RPAS) and Control Observers appear as the operational responses for turning the tide of systemic uncompliant behaviours relating to the landing obligation; a quasi-discard-ban obliging the fishermen to land all catches of certain species to which catch limits apply (quota species).

Conclusions

Looking at the global seascape, international commitments in the framework of Ocean Governance called for a dramatic increase worldwide of Maritime Protected Area (MPA) surface coverage. Such conservation instruments demonstrated that they could restore complex and fragile ecosystems to a good productivity level.

- Human observers can bridge the gaps of monitoring and surveillance of the MPAs.
- Human observers are part of the solution for curbing non-compliant behaviour, which damage the fishing resources and endanger the environment.
- Human observers are also instrumental for moving from weak and circumstantial evidence, to hard evidence, in relation to breaches to the provisions on the landing obligation.
- Incidentally, scientific bodies should take benefit from the data collected by the ‘control community’.

In conclusion, a possible way forward might be the implementation of specific control and inspection plans combining Control Observers, RPAS and ship borne e-Observation in an integrated approach, fostering cooperation and interaction between Control Observers and Fisheries Control and Inspection Bodies.

Let`s thank the observers for their resilience and instrumental contribution to compliance and conservation of fishing resources, often in very demanding conditions.

Session 1. Why monitor fisheries and what to monitor?

Leader: Steve Kennelly

This session explored the underlying reasons and requirements for monitoring fisheries. Through a series of case studies representing most parts of the world, it examined the historical, legal and stewardship-related issues that have led society, fishing industries, governments, NGOs, eco-labels, etc. to require fisheries to be monitored. It examined the many (and increasing) types of information needed from monitoring programs - for scientific, compliance and management purposes, to monitor bycatches of general discards and charismatic species, to monitor pollution, seafood traceability, eco-certification, etc. By sharing information about the lessons learned, and fostering increased collaboration among the world's observer community, this key session introduced elements that permeated throughout the rest of the conference.

Oral Presentations - Extended Abstracts

Chilean approach to understand and mitigate bycatch in fisheries

Luis Cocas

Under Secretariat for Fisheries and Aquaculture, Government of Chile

Introduction

Estimates by FAO (Kelleher, 2005) indicate that discard levels reach 8% of the world´s catches. According to this rate, during the period 1992-2001, annual discards would average 7.3 million metric tons. Additionally, it has been estimated that over 600 thousand specimens of marine mammals are caught incidentally every year (Read *et al.*, 2006) and a total of 700,000 seabirds die due to interactions with fishing operations. Although not monitored at sea until 2013, estimates for Chile by Kelleher (2005) established an annual discard average of 2%, with a higher incidence in trawl fisheries, particularly for hake and deep sea resources (offshore), and a low rate of 0.8% for small pelagic fisheries. On the other hand, in spite that Chile has signed international agreements and enacted regulations that protect marine mammals, sea turtles and seabirds and prohibit their hunting, the interaction of these groups with fishing activities has not been extensively monitored in the past.

These conditions may certainly threat the sustainability of the oceans. In fact, is currently thought that the depressed condition of many fish stocks, both locally and globally, is in part due to not having managed fisheries using an ecosystem approach and a comprehensive view, focusing mainly in the target species but neglecting the multiple interactions between different components that make up the fishing activity, including discards, bycatch, incidental takes, and essential habitats.

The ABC of Chilean approach to understand and mitigate bycatch in fisheries

A. Improved regulation and research

Considering this scenario and aiming to revert the negative trend of some of its fisheries, the Government of Chile changed its management strategies and incorporated as the main objective of its Fisheries Law (Ministerio de Economía, 2013), the conservation and sustainable use of the aquatic resources, by applying the ecosystem approach and precautionary principle in fishing regulation. Additionally, the Fisheries Law was modified, introducing new regulations on bycatch (discards and incidental catch), and establishing sanctions and modern control measures and tools for those incurring in such practices during fishing operations.

The term discard though, it has been previously introduced in Chilean legislation in 2001. However the 2001´s approach only prohibited discards and established strong sanctions to offenders, with no distinction between species and sizes. The heavy sanctions made fishers uncooperative and, while the practice of discarding continued as normal, discards became a taboo subject, unknown in magnitude to the Fishing Authorities.

In recognition of these issues, the 2012 revision of the Fisheries Law introduced exemptions to the discard (or bycatch) ban, conditional on a minimum 2-year fishery based research or monitoring programs in order to later develop and implement binding mitigation plans. The exemptions were applied to avoid fishermen altering their behavior and hence obtain unbiased information. Specifically the research or monitoring programs aimed to: (i) quantify and assess spatiotemporally through observers onboard, discards and the catch of seabirds, marine mammals and turtles associated with fishing operations, (ii) Identify and describe the causes of discards and incidental catches and (iii) along with fisheries users, propose changes (regulatory, operational, etc.) to the Fishing Authority, whose implementation would promote the reduction of bycatch.

Originally, the information had to be collected exclusively by fisheries observers on board, but because of coverage restrictions and to compromise fishermen with the outcome, they were also incorporated to the studies through self-report logbooks. To achieve fishermen support, an intense socialization program was deployed in the field to accomplish the fleet’s commitment

Further exemptions to the bycatch ban will apply as long as the following requirements are met: (i) research programs are completed and bycatch mitigation plans are established, (ii) sufficient technical background has been collected according to the protocols established by the research programs, (iii) the monitoring program continues to run, (iv) a global catch quota, which accounts for discards, has been set for the target species, (v) target and non-target species including incidental catch are subjected to mitigation plans, and (vi) discarding does not affect the conservation of the target species. Finally, there were restrictions on the use of previously discarded catches that will be lifted or reviewed within the remits of the mitigation plans.

B. Progressive reduction through binding mitigation plans

By March 2018, eight research programs have been concluded, and the respective binding mitigation plans have been enacted. These were extensively discussed with fishing users in workshop held at the Management Committees of the affected fisheries. Each Plan has considered the research Programs' results and mitigation proposals and include:

- Management measures and technological means to reduce bycatch
- A monitoring program to evaluate the effectiveness of the measures adopted
- A training program for fishermen
- A code of conduct for good fishing practices
- Government incentives for innovation in systems aimed to reduce bycatch

C. Compliance with the bycatch law and mitigation plans

Observer programs, carried out since 1990, were enhanced through this process with the enactment of regulations aimed to improve working conditions, training, safety, and data collection, however they continue with the sole objective of collecting data to be used in scientific advice for management, without any jurisdiction in compliance. Therefore, once finished the "non-sanctions" programs, the bycatch law and mitigation plans' compliance will be monitored through Electronic Monitoring Systems (EMS) onboard the entire industrial fleet by the end of 2018 and in the artisanal boats longer than 15 m by 2020.

Vessel owners shall install and operate with EMS. While SERNAPESCA (control and surveillance agency) will require and process directly or through external entities the information registered by the EMS. The requirements and conditions for implementing the EMS and the safeguards to prevent tampering or interference of the devices has been established through regulations, which make distinctions between fisheries, type of vessel and fishing gears.

The images recorded by EMS will be confidential. Its destruction, theft or improper disclosure will be liable to penalties provided in the Penal Code. When appropriated, the information generated by the EMS, certified by the SERNAPESCA, shall be considered a public document and could constitute a presumption to prove violations to fishing regulation.

Discussion

It has been a huge interest in the implementation of the bycatch law and its non-sanction programs, as the industry perceive the resulting transparency of their fishing operations as an opportunity to change fishing regulations and match fishing opportunities with their real catches. At the same time, Chilean society is increasingly concerned about the profitability and environmental impacts of fishing activities, and open to sustainability certifications. It remains to be seen if, despite the proposed changes in law and surveillance, the discard ban will be successful as Chilean fleets are large and extremely diverse in terms of gears, operations, and target species. In any case, it is expected that the increase in at-sea monitoring will change fishing practices, which will probably result in a change in fishing patterns and a reduction in unwanted catch.

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The Azores Fisheries Observer Program: an indispensable monitoring tool in the North Atlantic

Miguel Machete and Helder Silva

Institute of Marine Research – IMAR - University of the Azores, Horta (Azores, Portugal).

The Azores is the most isolated Archipelago in the North Atlantic, located half way between America and European mainland. It comprises 9 islands along a 600 km line and has an Exclusive Economic Zone of approximately 1.000.000 square miles with an average depth of 3000 meters. This area encloses multiple marine ecosystems and deep sea habitats such as deep hydrothermal vents (as I write this abstract news about the most recent finding of a DHV spot in the Azores are popping up in the daily news), deep water coral colonies, 60 large and 400 small seamount like features and is known to be one of the feeding and nursering hotspots in the North Atlantic for large predators. This unique habitats and the fact that coastal species are constrained to a small coastal strip due to the lack of continental shelf turns the Archipelago in to a very peculiar place. Fishing activities can only occur in 1% of the EEZ which makes resource management a high priority and changeling subject. There are four main fisheries in the Azores: pole and line for tuna (up to 8000 tons/year in a good season), pelagic longline for swordfish and blue shark (where most part of the catches caught in and around the Azores EEZ are landed outside the region), bottom long line and handline (multispecies fisheries with average annual landings of 3000 tons) and small net fishery for small pelagics (one of the few net fishing gears allowed in the area). Each one of them as specific issues that raises concern among managers: in the pole and line fishery is required Dolphin Safe certification to export canning and fresh tuna since the end 90’s. Besides, it is a two in one fishery, since it has associated a small purse seine fishery that supports live bait to the tuna fishery. There are several sensitive species associated with this activities such as cetaceans and sea birds in the pole and line and sea turtles in the pelagic longline, where this species together with some protected pelagic sharks are sometimes caught on hauls. Pelagic and bottom longline have also restrictions for target and by-catch species (quotas, minimum sizes) and are under the coverage obligations within the EU fisheries policy as well as the data collection framework (national program). The small scale net fishery for small pelagics is the only one allowed to catch those species and has regional restrictions for target species daily landings (eg: a maximum of 400 kgs of mackerel can be landed per day).

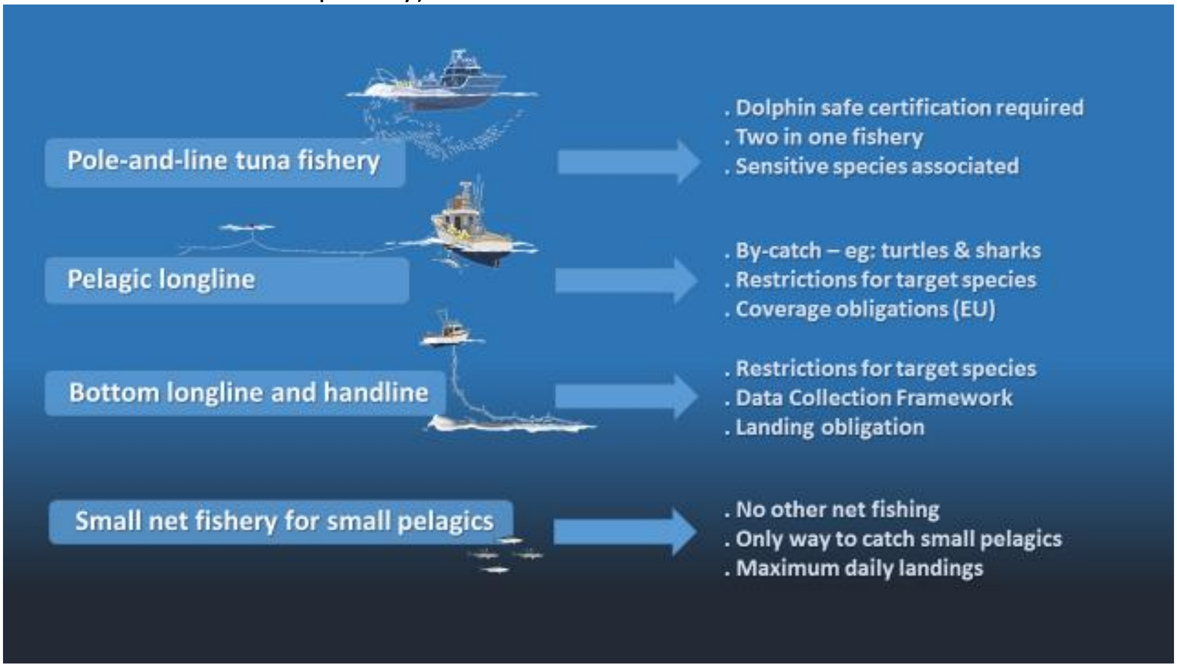

Figure1 – Main fisheries in the Azores and specific management issues associated (Pictures © Fishpics® & IMAR-DOP, Uaç)

The Azores Fisheries Observer Program (POPA) was created in 1998 to ensure dolphin safe certification to tuna fishery but quickly it's potential to become one of the main monitoring tools in the region was recognized. With a small executive commission (coordinator and chair) managed by the Institute of Marine Research (based on the Azores University) and funded by the regional government the Program was able to monitor the pole and line fishery in the last 20 years, having as partners fisheries and industry associations and certification NGO (EII). Despite the sporadically monitoring of some experimental fisheries since 1999 it was in the last 8 years that POPA started to cover in a more regular basis other main fisheries in the Azores: pelagic long-line and bottom longline/ handline). Those fisheries were the main targets of several international scientific projects such as DISCARDLESS (where the main goal was to achieve the gradual elimination of discarding) and COSTA (consolidating seaturtle conservation in the Azores) where the management of observers teams and data collection on board was assigned to POPA.

The POPA observers not only collect information about the fisheries (fishing gears, fishing operation, target species, by-catch) but also about associated species such as cetaceans, sea birds and turtles, marine litter and abiotic parameters. The Eco labelling certifications (dolphin safe and friend of the sea) achieved by the tuna fishery in the Azores were supported by POPA and all the produced scientific results brought essential knowledge to the north Atlantic area wherever it was trough reports for intergovernmental organizations (eg: ICCAT) or spacial information for global on-line databases (eg: OBISeamap). POPA data also allowed researchers and decision makers to face the emerging multitude of demands within the EU Fishery Policy: the Data collection framework directive (National Program) strongly targets long line and hand line activities and the by-catch landing obligation is eminent. For instance only recently an exhaustive overview of the discards issue in the main Azorean fisheries was accomplished including non-fish sensitive fishes such as corals and sponges. Spatial distribution of those taxa deep water colonies was also analysed trough data collection and live corals were brought by the observers to test recovery and later reallocation in natural habitats. Other EU diplomas such as the Marine Strategy Framework Directive (MSFD) are focused on other marine issues: within the MSFD scope Popa observers start to collect data about marine litter in 2015 so the regional government could be able to share with EU information regarding spacial distribution of the different types of marine litter in the surface of the Azorean EEZ. Moreover the Program and the observers team have also a major role in sensitizing fishermen for important ecological aspects such as marine pollution as well as establishing the bridge between them and science/governance players. To enhance those bounds and to reinforce fishermen confidence and knowledge on the Programs work the executive commission produces an annual publication for fishermen which includes geolocated maps from the previous year with tuna and live bait catches per month, so they can evaluated which were the most productive areas in the past season.

In short monitoring fisheries trough fishing observer programs such as POPA is one of the few ways to get crucial, robust, and reliable information. That kind of information is quite valuable on a regional and National scale but even more in the present European context since each member state is compelled to report frequently about fisheries catches, operation and associated species. With that said It is foreseen that the Azores Fisheries Observer Program will be the main information provider for the North Atlantic Archipelago in a near future monitoring in a regular basis the main fisheries that occur in the Azores area.

Indigenous Rights in Electronic Monitoring: Reconciling the Rights of Indigenous Peoples in Fisheries Management

Christopher Milley

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Increasingly more rigorous catch monitoring requirements and the need to enhance the quality of scientific information for fishery management have led to the introduction of new technologies for catch monitoring, such as electronic video monitoring (EVM). These efforts have been undertaken to improve management outcomes, and to protect stressed fish stocks and endangered species. The increase in electronic monitoring effort and the associated increase in quantity of monitoring data has been occurring at the same time as there has been a general recognition of Indigenous Rights and wider understanding of the importance of Indigenous traditional knowledge in fisheries management. To understand the potential benefits of Indigenous community participation in catch monitoring, the dichotomy of advances in at-sea monitoring technologies and the role of Indigenous coastal communities in catch monitoring must be understood.

The struggle of Indigenous nations for recognition of their territorial rights is well understood. Many Indigenous nations have used State legal systems and negotiation processes to successfully seek recognition of their rights and title over traditional territories, including fishery resources. More recently the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) has raised the issue of recognition within the international community. According to UNDRIP, Indigenous peoples have the right to their traditional lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired, and the right to own, use, develop and control resources in this territory. Furthermore, Indigenous peoples shall have the right to participate in the management of their traditional lands, waters and resources. In doing so, they also have the right to maintain, control, protect and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions.

Recognition of Indigenous Rights over fishery resources within traditional territories (waters) raises the question of how EVM can affect reconciliation of Indigenous Rights, particularly with respect to the relationship between EVM of Indigenous fishing activities and the impact on traditional knowledge (TK) systems. Traditional knowledge is a cumulative body of knowledge, practice and belief, evolving by adaptive process and handed down through generations by cultural transmission. TK is an important part of traditional Indigenous resource management systems.

Ownership of EVM is an important aspect of the reconciliation of Indigenous Rights and fishery data acquisition. Where data is owned and controlled by the State it maintains a control structure that does not reconcile with Indigenous management rights. This is particularly true for fisheries in which the harvest operations are undertaken by Indigenous communities or Indigenous enterprises. The intellectual property rights of Indigenous peoples is a matter of considerable international discourse since it can be an infringement of matters of cultural and spiritual practice, and undermines important aspect of management control over traditional resource harvesting areas.

Similarly, there are privacy issues regarding Indigenous crew activities during fishery operations in instances where data is owned by non-Indigenous Service Providers. Where EVM data is owned by the Indigenous community, the community can establish data use and sharing protocols that protect Intellectual Property, and the data can contribute to body of Indigenous traditional knowledge. This in turn can enhance the capacity of Indigenous nations to manage traditional resources in accordance with the UNDRIP principles. Some Indigenous nations see their use and control of EVM as useful in their efforts in Rights-based fisheries management, since it provides a means to verify compliance with Indigenous cultural, social and environmental management interests, and it can provide useful independent data to support their fishery management initiatives. Furthermore, EVM can be used to monitor harvest catch levels of non-Indigenous fishers working under Royalty fisheries to determine the vessel's royalty contribution to the community.

<u>Open Discussion Session</u>

Q. - Mention was made of observers and at-sea monitors by Sam Rauch of NOAA. What is the difference? Understand what an observer is, but not sure what is meant by the term of at-sea monitor.

A - At-Sea Monitors are a specialist type of observer that exist in the New England Groundfish fishery that just monitors the catch and sub-samples it for catch accounting. They do not receive as high a level of training as other observers.

Q – Most speakers have talked about fisheries dependent data, and as this session is about what to monitor and why, I am curious if you feel there is more and more pressure to gather as much data as possible from fisheries dependent methods because there are smaller and smaller budgets for independent research. And how do observers say no when you are asked to gather all data possible. At what point should observer programs push back and say that you will have to run a research project to collect that other data? Or do you think that you have to gather all the data necessary through the tools you have now, and there will be fewer and fewer independent surveys?
A - In the USA there is increasing pressure to monitor independently and increasing pressure to monitor the ecosystem – the budget is not shrinking, but the demand for information that is relevant continues to grow and the resources to monitor are not always continuing to grow. This is why we are looking at new and unique ways to fund our fisheries observer programs because there is so much pressure to observe many different things.
A - In South Africa there is an increased scope of what the observers have to collect. Need to make sure that not too much is asked for and to involve observers in decisions regarding what is being asked for.

Q - Some indigenous groups are wanting to run their own monitoring programs, including Electronic Monitoring. In what ways can this be accommodated?
A - In discussions with Government concerning this when they recognised title over the whole territory, one of the chiefs said: "We are the stewards of the territory, and everybody who lives in the territory we have an obligation to, not just to our own membership." Information that can be compiled from different sources being brought into people who feel a sense of responsibility. It's not just political and not just science. More of the social aspects are being considered and giving that focus to the discussion.

Q - Dockside monitoring – for other parts of the world, do you have dockside monitoring as well as at-sea observers? Currently there are at-sea observers who hop off the boat when it comes to port and do dockside monitoring. With the move to Electronic Monitoring, this could become a problem when you rely on EM and we don't have those observers for dockside monitoring any more.
A - Chile – We are going to implement EM on board, but observers have a different job and their work is not going to be affected by cameras on board and their work is not under threat from cameras. We are going to keep observers on board and try to increase their coverage. Cameras are for other things.
A - Pacific – We have some trips where EM and observers on both on board. The purpose of the camera verification is just for the catch. Sometimes the captain, the observer and the camera verifiers all say something different and this is a challenge to decide which information to accept as the correct data.

Q - EcoTrust acts as an umbrella organisation providing monitoring data for indigenous people. We collect observer data for them and have created a really big database for them. Some data goes to DFO Canada, some is logbook data, and some are stories of what people are seeing at sea, so they are collecting different types of data. The idea of the service

provider holding data in trust for industry, for indigenous people - where you are collecting more than what is a federal requirement, and especially as industry starts paying for their monitoring, the idea that it isn't data that is owned by Federal Agencies, but rather data being collected and vetted so that Federal Agencies can believe in it - but it's not their (Federal Agencies) data.
A - Privacy and data ownership is a big issue in the United States. Moving to industry paying for EM on their boats and if you do it right, the camera data is owned by the fishermen and it isn't Federal property. Federal Agencies have a right to have access to it and see it, but if it is owned by the fisherman it solves a lot of the privacy issues. That is a model we are more going to on this issue.
A - With the Canadian oil spill and clean-up, information collection by small boats was a matter of integrating more than just fisheries data. The data then remained with someone who is not using it for specific objectives, but it becomes a repository of information so aggregated data can get out for users, whether it's the DFO or others. This protects the rights of the individual. Allows DFO to get good data without compromising the science.

Q – The EM challenges and opportunities presented are similar to what has been seen in the US. We know that it is humans that catch the fish, report the fish, discard the fish and land the fish. With implementing EM, is it not so much about the fish themselves but what changes have been seen in human behaviour, human reporting and human fishing practices?
A - Pacific – The boats we used for EM were based on an MOU. No formal legal framework was followed to support the trial. But even so, it changes what fishers are doing on board. Crew were worried about where some cameras were to be placed, as it would show where they bathed. Crew know where the cameras can record – they look for blind spots – some activities occur out of view. So it's not a licence issue but it is a challenge that we are facing.
A - USA – The observer effect is known. Observer effects occur whether there's an observer on board or a camera on board. Have seen positive improvements with safety due to having observers on board, as observers can reject trips if the vessel is not safe. Cameras have changed things in a different way. Has fundamentally changed the way fishers bring the fish on deck sometimes, because they have to get it in front of the camera in a place where the camera can see it. There is an increased cost to fishers due to having to change this fishing practice in order to get the fish in front of the camera. And this changed practice is not seen with a human observer on board. More changes to fishing practices are needed with a camera that with a human observer.

Q - Using EM as an enforcement tool to investigate missing observers, but sometimes footage is missing when vessels return to port, citing that they didn't have storage for all the footage. Should there be some requirement for the vessel to store an adequate amount of footage?
A – Pacific – We use four hard-drives and are able to store footage for 60 to 90 day trips. But this is not under a legal framework, so we do not use any of the footage for compliance purposes.
Q - Then should be able to store all footage from 4 cameras for a 24hr period?
A - That is a technology question, but it is definitely able to be done. In the Pacific – it depends on the agreement or the requirement.

Q - Question regarding what to monitor. How do you determine what is a high priority? How best to prioritise?
A - Azores – We get told the priority. With the information we collect, we are able to give the requested answers. We collect a huge amount of data; not just about fish, but also about birds and other things. For example, we were asked by Government to collect information about marine litter on the surface and in the water column. Before that, we hadn't collected information about that. We discussed with observers if it is possible to do this and collect one more type of data, and we were able to do that.
A - Chile – At the start we did a lot of things wrong. Under-estimating total mortality was one of the weaknesses. We changed the approach. It is well known that ecosystem based monitoring has some benefits, but could require the collection of millions of bits of data to understand the ecosystem. We also need information on species other than target species to understand the bycatch. Also important for market requirements and societal concerns regarding mammals and birds. So we prioritised those things. Let's start with total catch and how many species are dying at sea and the interaction with other species at sea. That became the focus and then we move forward.

Q - How is data used regarding marine litter? Is it the vessels littering or is it litter that already exists in the sea? Does the data go to an enforcement agency or just to the Government to determine how much litter there is?
A - Azores – Our observers have no enforcement powers. We collect information in time blocks; both for litter already in the marine environment and how the vessel manages their rubbish. The information collected goes to the Government.

Q – The public wants access to data. But some data is confidential. So I ask about approaches to give access to data. How do you reconcile confidentiality and privacy? It appears that there is heightened interest in the data, even from the fishers themselves – sometimes to protect their interests and their fishing rights. Do you think there will be more public use, or presentation, of what we have historically deemed confidential data?
A - Chile – All information is on-line and available, but doesn't identify individual vessels or skippers that the information comes from. In fisheries with only a few participants, it is more complicated as it is easier to perhaps identify individual boats. Public money is used to collect, therefore the information has to be made available. All vessel names and skipper names are qualified though.

Q - Monitoring human rights and conditions on board. Are you doing that?
USA – don't have the authority right now to monitor for human rights conditions – other Agencies have the mandate to do it.
Chile – No – focused on other things – other Agencies have the mandate to do it.
Azores –We don't have a way or a plan to deal with it. Other Government departments deal with it.
South Africa - Thought that their conditions were bad until he went to some other countries.

Pacific – On Foreign-Flagged vessels, so it would fall back to the countries they come from and we can't do anything about it at this stage. First time I have heard mention of monitoring human rights issues on boats, so something to take back to his Ministry to have a look at.

Q - In Norway we don't have a specific observer programme, but we have good cooperation with the fishing fleet who do self-sampling. It is called a reference fleet, with no observers. Mention has been made of the importance of the observer's role in dialogues between scientists and fishermen and helping both groups understand. Each other. The question is how do we fill the role of dialogue between fishermen and scientists with a move towards EM systems?
A - USA – A number of out-reach programs. There are various ways (and groups) to engage with fishers. Not the role of observers specifically, but they can perform that function. We try to get the fishermen involved throughout the whole management design program.
A - South Africa – EM not there to replace the observer, but to complement observer work. If that is the general approach, then observer/fishermen communication will not be a problem.

Poster Presentations – Extended Abstracts

Observer Contributions to a U.S. West Coast Success Story

Ryan Shama

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Due to overcapitalization, the U.S. Secretary of Commerce declared the West Coast groundfish fishery a failure in 2000. Several factors contributed to this collapse, including insufficient stock assessment data, lack of at-sea discard monitoring, and increasing fishing effort, coupled with greater efficiency. With 5 species officially declared overfished and several others expected to join the list, it was clear that significant measures needed to be taken, in order to save the fishery.

To meet sustainability mandates, NOAA Fisheries had to adopt a strategy that would further limit access to the fishery, reduce catch of sensitive species, and significantly improve the quality and availability of fishery-dependent data for West Coast groundfish stocks. Consequently, several management actions were taken over the following years. These included an effort to better assess the stock status of rockfish and other federally managed species, the creation of the West Coast Groundfish Observer Program (WCGOP), designation of area closures known as Rockfish Conservation Areas, establishment of a Buy-Back program, and the more recent implementation of a Catch Share program.

The U.S. West Coast groundfish fishery is now in the midst of a truly remarkable success story. Of the 10 species deemed overfished between 1999 and 2010, all but 2 have been declared rebuilt, as of 2017. Observers played a crucial role in this recovery by providing accurate accounts of at-sea discards, a major piece of the puzzle which had previously been unavailable to fishery managers. Along with at-sea discard estimates, came a bevy of biological samples which continue to provide valuable fishery-dependent data for stock assessments.

While several factors have contributed to the recovery of the majority of West Coast overfished species, the observer component has been among the most significant. Prior to the deployment of fishery observers on West Coast groundfish vessels, fishery managers were missing a crucial piece of the puzzle, at-sea discards. Observers were able to fill that data gap, while also serving an important compliance and scientific data collection role. From 2002-2017, WCGOP observers accounted for **2,974,384.96 lbs**. of discards (expanded) from the 9 species represented in Fig. 1.

WCGOP observers continue to provide the primary component of fishery-dependent biological data, used for West Coast groundfish stock assessments. During their **82,830 sea days**, WCGOP observers have collected **biological data from 105,446 individuals** from the 9 species in Fig. 1 (2002-2017). The types and amounts of biological data collected from each of these species have varied over the years, based on the needs of stock assessors, fishery managers, etc. Types of biological data collected include: **length, sex, otoliths (age), and fin clips (genetics)**.

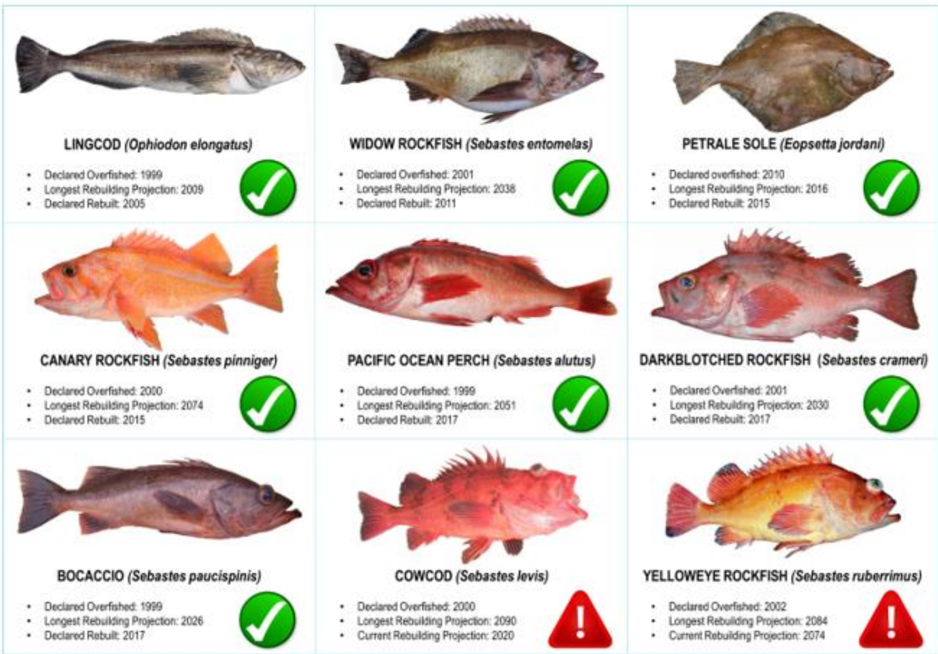

Figure 1 : West Coast groundfish species declared overfished since 1999. Pacific whiting excluded, due to the brevity of its overfished status (2002-2004) and relatively low impact on non-whiting groundfish fisheries.

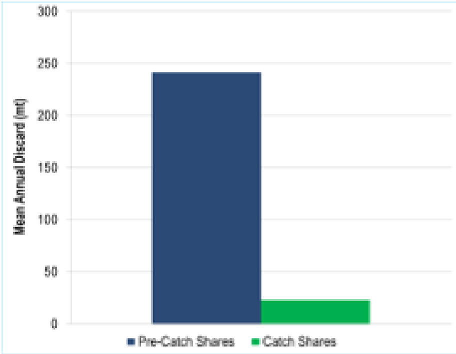

Figure 2 : Mean annual discards for the 8 overfished rockfish species and petrale sole. Pre-Catch Shares = 2004-2010; Catch Shares = 2011-2016.

The observer component became even more instrumental in the recovery of overfished species, when the Catch Share program was implemented on January 1, 2011. With catch shares, came the requirement for 100% observer coverage in the trawl sector. While controversial, this management strategy provided an immediate and significant reduction in the catch of overfished species, as demonstrated in Figure 2. Without observers providing the crucial compliance component, the Catch Share program would arguably have failed to provide the level of individual vessel accountability necessary for success. Not only did the WCGOP serve this important role, but it also provided the fast, reliable catch accounting needed for fishers to effectively and efficiently manage their quotas.

Thanks!

Special thanks to the 422 observers that have passed through our program, since it began in 2001. Also, to Stacey Miller (NWFSC/PEP), Kayleigh Somers (NWFSC/FOS), and Neil Riley (NWFSC/FOS) for their assistance in pulling together and presenting the data in this poster.

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OCUP: A Regional Observer Program for the French Tropical Tuna purse seine fleet in the Atlantic and Indian Oceans

A.Relot

Oceanic Développement, France

Introduction

The use of onboard scientific observers to monitor the activities of fishing vessels and collect fishing data for scientific purposes is requested by international law, the FAO guidelines for the promotion of responsible fishing practices and Regional Fisheries Management Organization's resolutions. In the case of the tropical tuna purse-seiners operating in several Exclusive Economic Zones (EEZs), the flag State as well as several coastal countries (through fishing agreements) are requesting the boarding of observers on board purse seiners.

Therefore, in order to comply with all these different regulations and commitments and since it is not possible to embark more than one observer during a fishing trip, the French producer organization ORTHONGEL (French Producer Organization of frozen and deep-frozen tropical tuna) representing French tropical tuna operators has imagined a program in both Atlantic and Indian Oceans to facilitate and optimize the boarding of well-trained scientific observers on the fleet of the fishing companies' member of ORTHONGEL.

This voluntary program is called OCUP for "Observateur Commun Unique et Permanent" (Common Permanent Unique Observer).

Definitions

OCUP is an innovative program promoting cooperation, transparency and capacity building in order to deploy regional observers with a unique status onboard 12 French tropical tuna purse seiners with an ambitious objective of 100% coverage rate. The program addresses the requests of different origins with potential different contents in terms of observation aboard French seiners: (i) IRD for mandatory (EU Data Collection Framework – DCF, R(CE) 199/2008) or additional scientific data collection, (ii) French administration in compliance with RFMOs' regulations, (iii) coastal States in compliance with fishing agreements obligations (Sustainable Fisheries Partnership Agreement – SFPA – signed with EU or private agreements signed with ORTHONGEL), and (iv) fishing companies to certify commitments made in the frame of responsible fishing schemes.

General organization of the Program

All coastal countries are invited to actively join the program to participate in the program steering committee, OCUP observer selection and scientific data collection. To date, coastal countries involved in the program are, in the Atlantic Ocean: Republic of Guinea, Mauritania, Ivory Coast, Gabon, Sao Tomé & Principe and Senegal; in the Indian Ocean: Comoros, Madagascar, Seychelles and Mauritius.

Since the beginning of OCUP, actions have consisted in:

Defining with other stakeholders the priorities and conditions of boarding to guaranty the security, reliability and independence of scientific observers in accordance with minimum standards internationally agreed;

Setting a coordination for a permanent boarding of observers on all French (12) purse seiners;

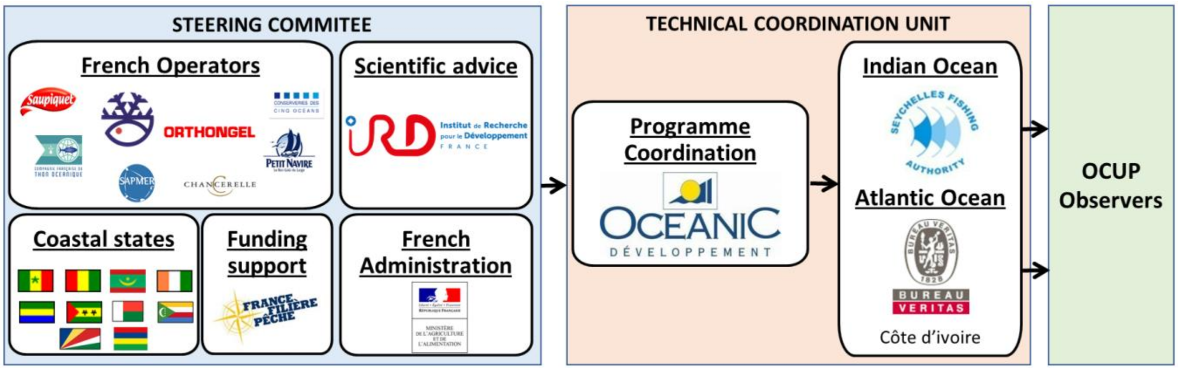
Elaborating and providing a specific training for national observers from (and designated by) coastal countries willing to participate;

Implementing procedures to board, manage and debrief observers as well as collect, verify and archive validated data and establishing access rules to the archived information;

Implementing tools to communicate mandatory data and reports to relevant fisheries administrations (flag State, coastal State mandating the observer or coastal States which EEZ were visited during the fishing trip) and scientific institutes.

From its beginning in 2013, the program is coordinating by Oceanic Développement with the support of the French Institute of Research for the Sustainable Development (IRD), the Seychelles Fishing Authorities (SFA), Bureau Veritas Ivory Coast and several coastal countries. The coordination of the program and the training of observers is funded by ORTHONGEL, France Filière Pêche (FFP) and French canneries (see http://www.orthongel.fr/ocup.php for more information).

OCUP Program organization chart:



Training of observers

OCUP observer candidates are nominated by relevant fisheries administrations for national observers or selected by the steering committee from their curriculum vitae for other observers. All potential observers are then evaluated by the steering committee. Two training sessions have been organized in the Indian Ocean (May 2014 and June 2015) and two in the Atlantic Ocean (May 2014 and November 2016). During these two weeks training sessions, the observers follow specific training items as tuna fisheries presentation, species identification, OCUP observer tasks and reporting, national and regional regulations, maritime safety,...

Following this training, an "OCUP certificate" is delivered by the steering committee to the observer. Since 2017, the observer receives a "fisheries observer individual passport" gathering all information on his/her training sessions, accreditations and work experiences as observer.

OCUP Observers trained from the beginning of the program (in the Atlantic and Indian Oceans):

Observers' nationality	Trained	Embarked
French	41	41
Ivorian	31	28
Gabonese	4	4
Guinean	4	3
Mauritanian	2	2
Sao Tomean	4	3
Senegalese	6	5
Total Atlantic Ocean	43	37
Seychellois	18	17
Comorian	4	3
Malagasy	6	5
Mauritian	4	0
Total Indian Ocean	32	24

OCUP observer tasks

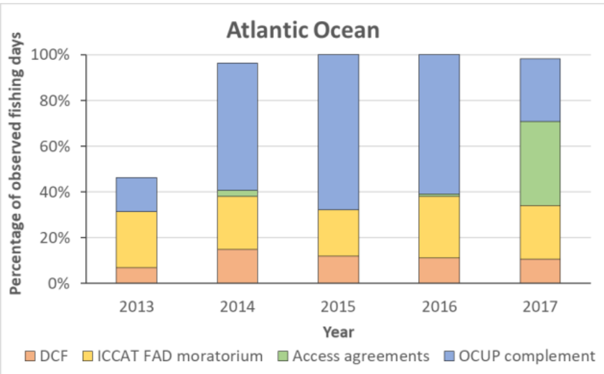
OCUP observers are primarily in charge of collecting mandatory scientific data and information on the application of ORTHONGEL best practices. Control is not part of the mission of OCUP observers, however all collected data is made available to coastal States with an objective of full transparency.

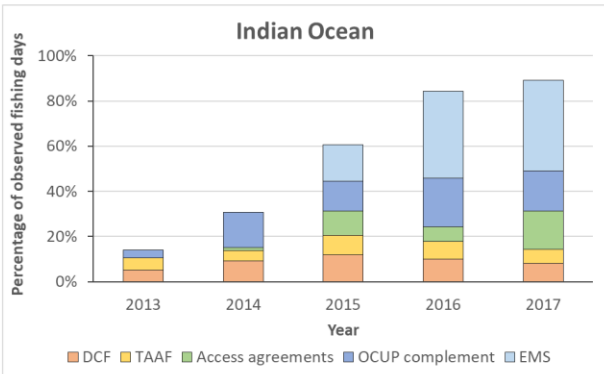
Report and data sharing

Observers are in charge of drawing up a report for each trip. Report templates and Excel files generating standardized analyses and graphs are provided by Oceanic Dévelopement. Data are transferred to IRD ObServe database and reports are stored on a server allowing all authorized to download the reports. The url of this server called Obsweb is https://www.obsweb.org/ocup/.

Report type	Content	Recipients
Summary	**General information on the fishing trip** (date and port of departure and landing, EEZ visited, number of fishing sets, tuna catch, purse seiner, observer, problems encountered by the observer and infraction suspicion when applicable)	All stakeholders
Full Report	**Detailed information on the fishing trip** (Overall overview on the vessel activity, fishing details, tuna catch, bycatch, discards when applicable, activities on Floating Objects, species size measurements, etc)	Flag state and observer authority
EEZ Report	**Detailed information** of the full report, only for the relevant EEZ	Relevant coastal authority

Results of the OCUP program:





Before the implementation of OCUP, fishing trips were partially covered within the EU – DCF framework (10%) or ocean specific programs (ICCAT moratorium on Fish Aggregating Devices - FADs, French Indian Ocean Territories - TAAF). OCUP provided the complement to these observer programs and, since 2013, the coverage of fishing trips has quickly increased to reach 100% for the Atlantic Ocean in 2015 and 89.1% for the Indian Ocean in 2017.

The objective of OCUP is to achieve a coverage of 100% of fishing trips in a near future, with on board observers and with electronic observers as a complement.

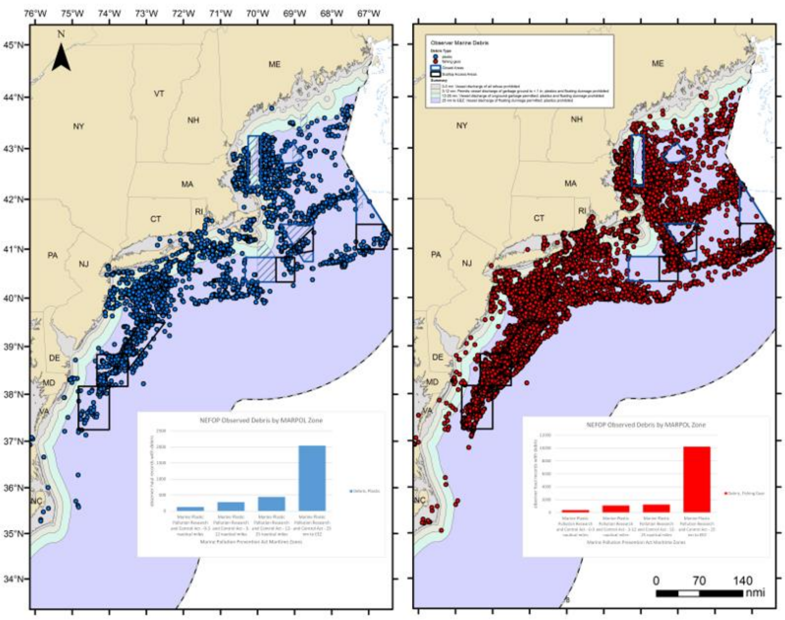
Observing the impact of plastics in the Atlantic Ocean

Zachary Fyke

AIS Observer

As far back as the 1960's plastic has been documented in the Atlantic Ocean. The presence of these plastics has greatly affected terrestrial and aquatic species. Plastics impact a wide range of aquatic environments from riverine to the Pacific Ocean Gyre. However, less current information exists on plastics in the Atlantic Ocean. The objective of this research is to explore the role of plastics caught within the fishing industry operating off the coast of New England. For the health of the fishery as a whole, and to ensure there are still fisheries for future generations, it is imperative that we start packing out the plastic brought on deck. Recording and bringing the plastic back to land will increase the knowledge of the extent of plastic pollution in the Atlantic Ocean. Together with effort of fisherman and data from observers, we can do our part to clean up the world's ocean.

With the expansion of developing nations, packaging materials are going to continue to be one of the top items entering landfills. This means cardboard, metal, and plastic. Paper supplies to break down over time but plastic does not. It may break down into a substance called a microplastic, but never actually goes away. Microplastics are found in all of our world’s oceans. Microplastics are between 1-5 mm in size and are easily ingestible by marine life. They become part of the trophic cascade, being consumed my microorganisms, who are consumed by fish, who are consumed by marine mammals, and so on. Humans that consume fish are also potential consumers of microplastics.



This figure shows two different maps. The one on the left is the known locations of Marine Debris, Plastic plotted from data from marine observers from the past 9 years. The map on the right is the known locations of Marine Debris, Fishing Gear plotted from the data from marine observers from the past 9 years. Both of these maps show a higher accumulation of points outside of 25 nm from shore. In the case of Coast Guard MARPOL, plastic is not allowed to be discarded anywhere in the ocean. Major sources of the plastic in the ocean are shipping vessels, commercial fishing vessels and debris from land. It takes all of us working together to limit the amount of debris that is in the ocean, and to start cleaning up what has already been discarded.

One way that humans could limit the amount of "one use" plastics is by telling the producers that we no longer want these. Every time we go get a coffee with a straw, it is often only used once, and discarded to the trash. From the trash it goes to a landfill, only to breakdown to smaller and smaller pieces of plastic. Try packing your own reusable coffee cup and reusable metal straw. When you walk through the market the next time, notice what everything is packaged in. PLASTIC. Often our goods are plastic, packaged in plastic, only to be loaded into a plastic bag to be taken home. There are reusable options to all the "one use" items we use on a daily basis. It takes us as consumers to speak up for what we want.

Monitoring to support the fishing sector and territorial management: São Paulo State Case, Brazil

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<u>Background</u>

Fishing monitoring has historically been carried out with the aim of supporting the management of the fishing activity by a governmental authority (FAO, 1998). According to the Guidelines for Responsible Fisheries (FAO, 1997) data and information gathered are required at different levels of management, namely: policy formulation, formulation of management plans, and the determination of management actions to implement the policy and plans. Having the best information available coastal States should optimize the utilization of its living resources in the exclusive economic zone ensuring proper conservation and management measures (UN, 1982).

The implementation of a sound management, preferably oriented towards the conservation of the ecosystems (ecosystem-based management - EBM) is still a challenge for most nations. The assessment of the fisheries management compliance with the principles of EBM in 33 different countries (Pittcher, 2009) indicated that only a few could be considered adequate. Although some developing countries have had indices comparable to developed ones, most of them presented poor performance ratings in relation to EMB principles, indicators and implementation.

Most developing countries are in tropical areas where species diversity higher and fisheries are based on small stocks and multispecies assemblages (Mahon, 1997). Typically, the small-scale fisheries sector plays an important role in relation to local socio-economic and cultural aspects. Fisheries statistics are frequently not collected or are unreliable, reflecting in part the governmental priorities in fisheries relative to other sectors of the economy, and in part, the total size of the budget itself (Caddy & Bazigos, 1985; Blaber, 1999).

Fisheries monitoring in Brazil started in the 1940's, with the publication of the Fishing Yearbook in São Paulo State in 1944 (Vieira, 1945). National data became available only from 1952, as part of the Statistical Yearbook of Brazil published by the Brazilian Institute of Geography and Statistics. Unfortunately the formulation and implementation of public policies for the fishing sector has been strongly impacted by political arrangements and institutional instability.

Since the 1960s, the responsibility for fisheries management has gone through the Ministry of Agriculture, Livestock and Food Supply (1962-1989, 1998-2002, 2015-2017), the Ministry of the Environment (1989 to date, partially), the Ministry of Fisheries and Aquaculture (2009-2015), the Ministry of Industry, Foreign Trade and Services (2017-2018), as well as some special secretariats subordinated to the Presidency of the Republic or its General Secretariat (2003-2009, 2018). Between 1990 and 1994 there was a collapse in the fisheries monitoring system in Brazil and for most species the values reported in the Yearbook were estimated. Another discontinuity in the fishery information and data collection system occurred in 2008, when the attribution of monitoring was transferred from the Ministry of the Environment to the Ministry of Fisheries and Aquaculture, and persists to date. The last National Fishery Yearbook with data obtained in the field dates from 2007. Between 2008 and 2011, landings for most species were estimated on the basis of values from previous years or from sample expansion.

Marine Fishing Monitoring in São Paulo State

Since the 1940s, São Paulo State has maintained some agency linked to the Department of Agriculture focused on fishing activity. The Fisheries Institute of São Paulo State was the only institution in Brazil to keep record of marine fishing landings uninterrupted from 1967 to the present. This is due to its organizational structure and stability, its independence from the federal government, the ability to raise external funds and its aim at monitoring. In addition to the classic motivation for the fisheries management, the monitoring is also intended to support the fishing sector, the management of fishing territories within Marine Protected Areas and compliance with environmental licensing.

Data is acquired by the census method through voluntary dockside interviews with fishers. In addition, data is obtained from self-reports, fishing logs and marketing reports (Fig. 1). Socioeconomic information is used to complement or validate interviews. Data is registered by hand in a form for later typing or inserted in the database through an app named ProPesqMOB. Annually, landings of 80 thousand fishing trips are recorded at around 200 fishing landing sites along a coastline of 620 km. Information on fishing grounds, fishing gears, effort and landings by species is obtained for each trip. Furthermore, socioeconomic information is kept updated. The data is stored at ProPesqWEB database, a system developed on Open Source technologies and with a flexible interface for queries. It allows cloud and local usage and easy integration with programs like QGIS and R. ProPesqWEB is built on the PostgreSQL object-relational database system with the PostGIS spatial database extender and installed on a Linux CentOS server. HTML, php and MapServer are also used in the system. For a more flexible use in local networks, one can download the dumping file from the web server and expand it on a computer with both PostgreSQL and PostGIS installed.

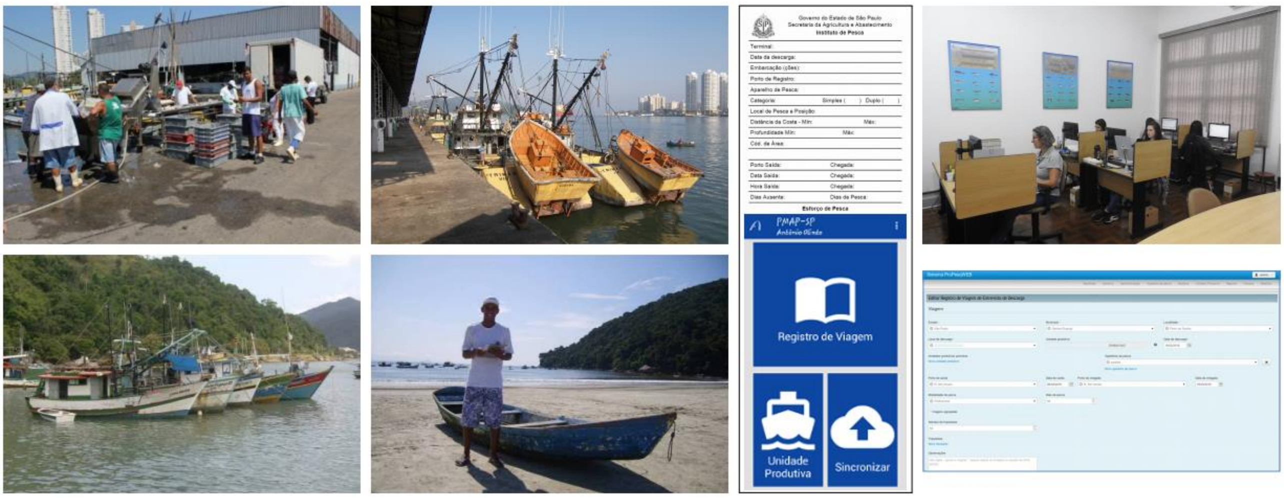

Fig. 1 – Monitoring, processing and storing information from marine artisanal and industrial marine and estuarine fishing fleets in São Paulo State, Brazil.

Besides supporting academic studies and different spheres of government, ProPesqWEB allows to produce reports for fishers to use for renewal of the fishing license and to access unemployment insurance of the closed fishing season or bank loans. Stored fisheries data also support local agreements for specific fisheries, reports on sustainable fishing in marine protected areas and assessment studies on the interference of other economic activities on fisheries, in particular oil & gas and port activities.

Queries can be made directly to www.propesq.pesca.sp.gov.br website. As of 2016, the monitoring framework developed in São Paulo was expanded to other States of southern and southeastern Brazil and ProPesqWEB started to be used and updated in a consortium with different institutions. Although teams are independent, methodologies applied are compatible and data is stored on the same platform, which facilitates data consolidation and analyses on a larger spatial scale. The States that currently use ProPesqWEB account for at least 40% of national marine fisheries production. The experience described may contribute to the implementation and maintenance of fisheries monitoring programs in unfavorable conditions and to the integration of teams, as well as to the organization and sharing of data.

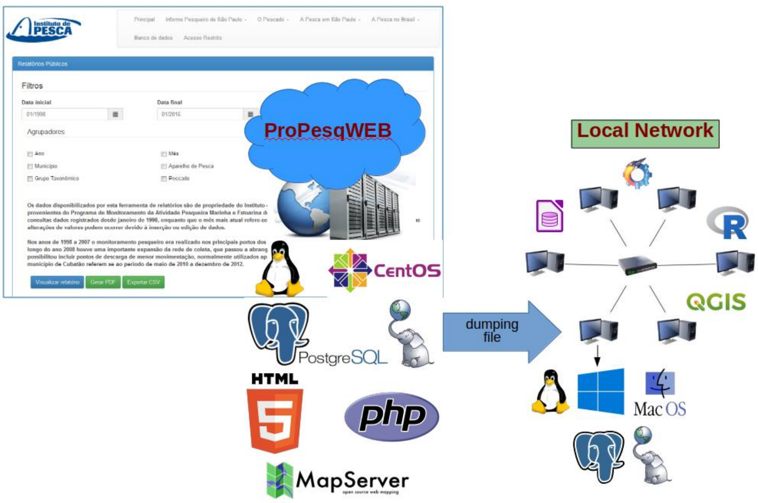

Fig. 2 – ProPesqWEB fisheries database website, environment, workflow and integration capabilities. www.propesq.pesca.sp.gov.br

Conclusions

The information obtained by fishing monitoring programs can be an input to the productive sector. Once disseminated it can be embraced by fishers, especially artisanals, and other stakeholders to solve conflicts and to help them in the planning of their activities. Excellent results have been obtained in São Paulo State with the participatory monitoring and the application of census methodology through voluntary interviews. ProPesqWEB database is an important tool for achieving the objectives.

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Interactions and incidental mortality of marine birds associated with fisheries in Argentina: period 2011 – 2015

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Introduction

The information shown here was presented to the Federal Fisheries Council through the Undersecretariat of Fisheries and Aquaculture of the Ministry of Agribusiness and the Secretariat of Environmental Policy, Climate Change and Sustainable Development under the Ministry of Environment and Sustainable Development, as a continuation of previous reports presented since 2003 in follow-up to that expressed in the Resolution of the CFP N ° 03/2001. This document presents information on the interaction levels (including incidental mortality or bycatch) of seabirds associated with longline fleets, surimi processors, ice/fresh trawlers and freezers during the 2011-2015 period.

The information presented is a compilation of data taken with the joint effort of the Observer Program from the National Institute of Fisheries Research and Development (INIDEP), the Albatross Task Force from Aves Argentinas, and the Vertebrate Group from the Institute of Marine and Coastal Research (University National of Mar del Plata - CONICET).

In addition to providing information for an update on the levels of interaction and incidental mortality of birds in fisheries in Argentina, the purpose of this report is to define the status at the time of publication of the BIRDS National Action Plan - so that it can be used as a level reference - and show the degree of implementation of NAP BIRDS in general terms and in particular with regard to the development of performance indicators thereof, and the implementation of existing conservation measures (for example, Resolution of CFP No. 08/2008) and others to be developed and implemented in the future.

It should also be noted that some important values of bird watching efforts are the product of resources and resources assigned by groups such as the Albatross Task Force (Aves Argentinas) or the Vertebrate Group (IIMyC, National University from Mar del Plata - CONICET), which they are specifically focused on the identification of certain problems.

Materials and methods

During the reporting period (2011-2015), interaction records with seabirds were analyzed, from a total of 22 trips in longline vessels, 18 surimi processors, 74 ice/fresh trawlers (side trawlers and stern trawlers combined) and 14 freezers.

Number of total fishing trips analyzed and number of trips with information on interactions with birds (in brackets). In Ice/fresh trawlers, the two numbers in brackets indicate trips observed in side trawlers and stern trawlers, respectively.

	2011	**2012**	**2013**	**2014**	**2015**	**Total**
Freezer trawlers	66[0]	25[3]	36[3]	28[6]	29[2]	184[14]
Ice / fresh trawlers	181[14-4]	126[14-3]	119[15-3]	160[12-2]	140[6-1]	726[61-13]
Surimi processors	6[3]	10[6]	6[5]	6[1]	8[3]	36[18]
Longliners	16[15]	18[0]	9[3]	11[3]	7[1]	61[22]
Total	**269[36]**	**179[26]**	**170[29]**	**205[24]**	**184[13]**	**1007[128]**

The asymmetry evidenced in terms of the degree of observer coverage and difficulties in determining incidental mortality in different fishing strata (particularly between longliners and trawlers) makes a particular effort in trawler fleets (both ice/fresh and freezer vessels) essential to quantify the interaction levels and consequently define risk levels through proximal indicators.

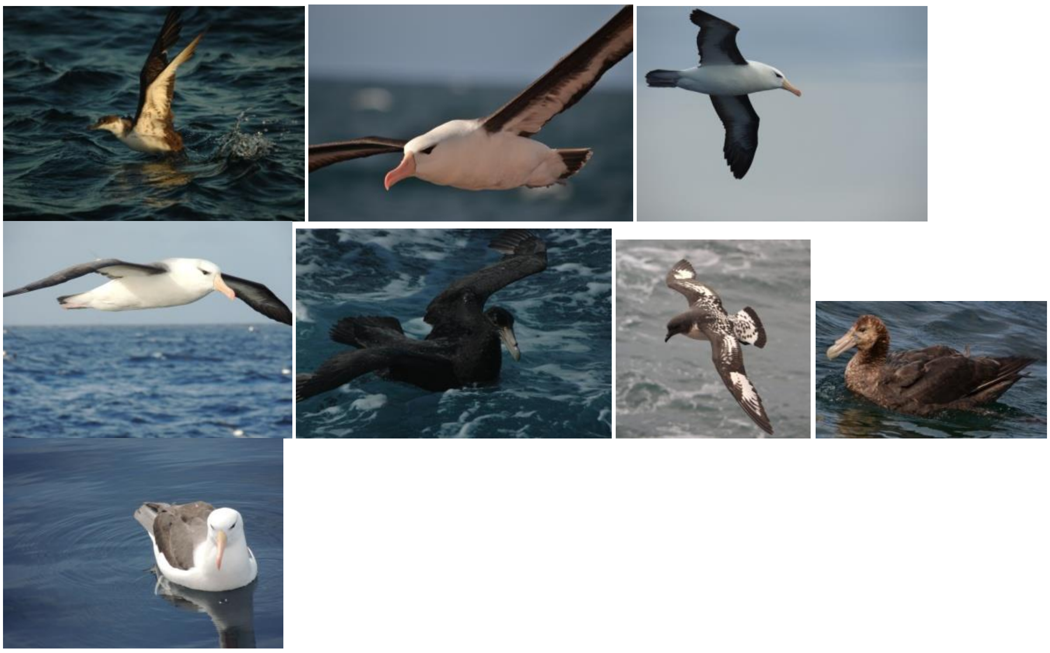
Type vessel per year	Trips	Abundance censuses (1)	Interactions censuses (2)	Observed mortality (3)	Hauls	Collisions / Mortality (4)
2011						
Side trawlers	14	275	224	5	310	3401
Stern trawlers	4	36	21	1	39	157
Freezer trawlers	-	-	-	-	-	-
Surimi processors trawlers	8	70	3	3	74	298
Longliners	15	129	2	2	2454	10
2012						
Side trawlers	14	255	243	4	193	2263
Stern trawlers	3	46	10	1	46	106
Freezer trawlers	3	150	297	1	119	1516
Surimi processors trawlers	6	222	203	5	204	478
Longliners	-	-	-	-	-	
2013						
Side trawlers	15	350	307	5	170	1273
Stern trawlers	3	20	13	1	19	673
Freezer trawlers	3	69	55	0	65	182
Surimi processors trawlers	5	175	171	3	125	519
Longliners	3	81	21	1	59	33
2014						
Side trawlers	12	208	189	4	124	117
Stern trawlers	2	26	19	1	25	32
Freezer trawlers	3	342	503	6	246	415
Surimi processors trawlers	1	0	1	1	1	1
Longliners	3	64	21	1	47	45
2015						
Side trawlers	6	79	82	3	66	219
Stern trawlers	1	8	8	0	8	1
Freezer trawlers	2	249	484	2	125	1217
Surimi processors trawlers	3	130	145	2	105	405
Longliners	1	1	0	0	1	0

(1) Censuses to determine abundances by species of birds associated with trawlers during different moments of the fishing operation; (2) censuses to quantify the levels of collision with fishing gear and its severity; (3) number of trips in which incidental mortality of birds was observed; (4) number of collisions of birds observed (in trawlers) and dead birds recovered during hauling (in longliners).

Results

It should be noted that in the column collisions / mortality information is presented about the number of interactions registered with fishing gear (not necessarily all serious or fatal) in the trawler fleets, while in longline vessels, the number of birds killed and recovered during the maneuver of rigging is quantified.

A detail of the species of birds affected by the interaction with fishing vessels (this is with confirmed incidental mortality) shows that marine birds such as albatrosses and petrels are the main affected species. This is possibly due to the fact that a good part of the reported fisheries operate mainly in the high seas where this group of birds is dominant over coastal species such as gulls, terns, cormorants, skuas or penguins.



Detail by year and fishing stratum of the number of dead seabirds according to the point of contact with the vessel and / or fishing gear, in the tides observed. EXU: Wandering albatross (Diomedea exulans); ARS: Southern Royal Albatross (D. epomophora); RNA: Northern Royal Albatross (D. sanfordi); ACN: Black-browed albatross (Thalassarche melanophrys); PG: Giant Petrel (Macronectes spp.); PBB: Petrel white beard (Procellaria aequinoctiallis); PDA: Checkerboard Petrel (Daption cápense); PCN: Black head shearwater (Ardenna gravis); PMA: Magellanic Penguin (Spheniscus magellanicus); OCE: Common paiño (Oceanites oceanicus). No ID: unidentified seabird. NET: fishing net, NSC: net sond cable; WW: warp wire; SHP: ship; BSL: bird-scare line; BST: ballast; HK: fishhook.

	Number of dead birds observed											Contact Point						
Vessel type per year	**EXU**	**ARS**	**ARN**	**ACN**	**PG**	**PBB**	**PDA**	**PCN**	**PMA**	**OCE**	**No ID**	**NET**	**NSC**	**WW**	**SHP**	**BSL**	**BST**	**HK**
2011																		
Side trawlers						2						2						
Stern trawlers	1			4								3		2				
Freezer trawlers				1								1						
Surimi processors trawlers				11			1					7	5					
Longliners				2		1	7											10
2012																		
Side trawlers				2				2	2			6	1					
Stern trawlers				2[*]					1[a]									
Freezer trawlers				11	1		1					2	11					
Surimi processors trawlers				34	4		1					34	4	2		1		
Longliners																		
2013																		
Side trawlers		1		3				46	13		2	65						
Stern trawlers				1								1						
Freezer trawlers																		
Surimi processors trawlers		2		14	1[a]							17						
Longliners				1													1	
2014																		
Side trawlers				2				8			2[b]	9	1		2			
Stern trawlers				5								5						
Freezer trawlers	1	11	1	12	5[a]		4					1	25	2	6			
Surimi processors trawlers				29	5		8						42					
Longliners				2														2
2015																		
Side trawlers						9						9						
Stern trawlers																		
Freezer trawlers		3		63	2[a]							10	46	1				
Surimi processors trawlers				32	10[b]		3					17	5		1			
Longliners										1								
TOTAL																		
Side trawlers	**0**	**1**	**0**	**7**	**0**	**11**	**0**	**56**	**15**	**0**	**4**	**91**	**2**	**0**	**2**	**0**	**0**	**0**
Stern trawlers	**1**	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**9**	**0**	**2**	**0**	**0**	**0**	**0**
Freezer trawlers	**1**	**14**	**1**	**87**	**8**	**0**	**5**	**0**	**0**	**0**	**0**	**14**	**82**	**3**	**6**	**0**	**0**	**0**
Surimi processors trawlers	**0**	**2**	**0**	**120**	**20**	**0**	**13**	**0**	**0**	**1**	**0**	**75**	**56**	**2**	**1**	**1**	**1**	**0**
Longliners	**0**	**0**	**0**	**5**	**0**	**1**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**12**

(a) Southern giant petrel M. giganteus; (b) Unidentified albatross; (*) Unidentified contact point.

It can be seen that the species mainly affected by fishing activities are the Black-browed Albatross (59% of the observed deaths), followed by the Blackheaded Shearwater (14%), and the giant petrels (7%) and checkers (6%). . However, it should also be noted that in some species that are caught in smaller numbers as large albatrosses belonging to genus Diomedea (eg wandering Albatross D. exulans, Northern real D. sanfordi and Southern D. epomophora as species with confirmed mortality in trawlers) the impact on the populations could also be significant when considering the reduced population sizes and low productivity of these seabird populations.

The incidental mortality rates in longliners have fluctuated in recent years, going from 0.025 birds per 1000 hooks set in 2008 (321 birds killed on almost 13 million hooks set), to 0.051 birds per 1000 hooks in 2009 (268 birds killed on more than 5 million hooks), and 0.003 birds per 1000 hooks in 2010 (9 birds killed over 3.3 million hooks set).

The low mortalities registered during 2010 can be associated with the implementation of the Resolution of the Federal Fisheries Council N ° 08/2008 (regulated in 2010), the reduction in the number of operational vessels, the cessation of activities of the longline stratum that operated on the resource " rays ", the use of gear (" cachaloteras ") with higher sinking rates in at least two vessels, or a combination thereof. To date, there is no robust information to define the levels of implementation of conservation measure Federal Fisheries Council No. 08/2008, although this is expected to be reported in future reports. It is also important to note that the use of the referred "sperm whales" should be monitored when suspected that they can cause problems associated with the ingestion of hooks by discarding fish heads containing hooks difficult to extract.

Pacific Islands Regional Fisheries Observer Briefing and Debriefing “ How We Do It”

Philip Lens

Pacific Islands Forum Fisheries Agency

Introduction

The Pacific Islands Regional Debriefing Policy was first developed, reviewed, approved and recommended at the 6th Pacific Island Regional Fisheries Observer Coordinators’ Workshop (ROCW6) in January 2006. The policy was called the Western and Central Pacific Island Observer Programmes Regional Observer Debriefing Policy. Since 2006 there have been major movements in observer activity in the region not least of which are: the adoption of the WCPFC CMM 2008-01 prescribing 100% observer coverage of purse seine vessels and 5% coverage of longline vessels; and development of Pacific Island Regional Fisheries Observer (PIRFO) Certification and Training Standards for the PIRFO Observers and Debriefers that work for the Pacific Island members of FFA and SPC that have been endorsed for use at the 67th Forum Fisheries Committee (FFC) meeting in May 2008. The standards include a PIRFO Certification and Training Policy Manual that outlines the make-up of a Certification Management Committee (CMC), charged with overseeing the certification of observers, observer debriefers and observer trainers.

Addressing the immediate demand for a five plus fold increase number of trained observers has fully occupied Pacific Island Observer Programme support staff since the inception of CMM 2008-01 at the expense of development of the debriefing processes that should accompany that increase. In recognition of this predicament there was call from the 9th ROCW in Noumea in September 2009. The US National Marine Fisheries Service (US-NMFS) and the Western and Central Pacific Fisheries Commission Regional Observer Programme (WCPFC ROP) responded by offering to host and facilitate a regional debriefing workshop to develop a plan of action that will lead to a satisfactory programme of debriefing. This workshop provided the ideal opportunity to review and update this regional debriefing policy.

Rationale

PIRFO Observer Programme Managers and Coordinators are responsible to ensure that data collected by their observers fully accomplishes the goals of their programme, meet WCPFC obligations, and is of consistent high standard. For observer programmes working to PIRFO guidelines, providing rigorous and regular debriefing to their observers is a required step in this process.

Debriefing provides a mechanism to:

- quickly report, and action if necessary, critical incidents that took place on the trip;
- give observers timely direct feedback on how they can improve their data;
- flag data that does not meet the specific quality requirements of data users;
- give Observer Coordinators feedback on their observers performance;
- verify data forms before distributing them to other agencies (FFA, SPC, PNA, SPREP etc);
- explore, through questioning, if additional information can be gathered about the trip;
- judge if the quality of the data has suffered through harassment of the observer;
- assess the skills and experience for pay and promotion purposes;
- find out if special consideration is necessary for future placements on that or like vessels

Whenever possible, debriefing should be carried out personally between a certified, skilled observer debriefer and the observer. It is important to regularly fully debrief all observers at any experience level.

PIRFO briefing

Observer Coordinator identifies a suitable observer for a trip after checking the observer's previous record in data collection, data compiling and debriefing scores to assess his/her performance on the particular vessel gear type. Contact is established with the observer to confirm their availability and readiness for the trip. The observer is further assessed through a face-to-face cross-examination on their health, mental and physical status by the Observer Coordinator. All observers engaged for trips should be 100% fit, without illness or family issues that might affect their performance whilst at sea.

Upon identifying an observer for a trip, a written brief is prepared by the Observer Coordinator and handed over to the observer prior to taking that trip. The observer is also given the opportunity to seek further clarification on the brief. The brief outlines the purpose of the trip, the observer's ID number, the vessel to board, the type of vessel, port of embarkation, estimated time of departure (ETD), the name of the Placement Officer, the vessel particulars (license number and call sign) and a simplified guide for the observers to read and digest whilst on duty. The observer professionalism and code of conduct is also referred to during the briefing session by the Manager/Coordinator.

During the briefing process, the Observer Coordinator provides the observer with the necessary resources to carry out their duties diligently and effectively including the workbook/forms for data collection, fish measuring equipment, and the safety gears. Observers are continuously monitored while at sea via the two-way communication device and Personal Locator Beacon (PLB). Some programmes are using the Fisheries Information Fisheries Management System (FIMS) to report near real-time regarding emergency situations through the Android tablet and two-way communication device.

A formal Notice of Intention to place an Observer is prepared by the Observer Coordinator and send to the vessel operator advising them of the intention to place an observer on the vessel. Travel arrangement are made through the travel agent for observers when boarding vessels away from their home port, while home port placements is facilitated by a local placement officer who takes the observer to the harbor or dock for placement formalities.

The Observer Coordinator liaise with vessel Agent or Company Representative to meet for a formal placement meeting. The purpose of the placement meeting to thoroughly explain to the Captain the purpose of placing an observer and the vessel obligation towards the observer whilst they are on the vessel until they disembark and are debriefed. The vessel Master/Captain then signed off the placement form as an agreement to comply with observer requirements and taking on board the observer.

The Observer Coordinator is aware of the observers' arrival in port through the mandatory weekly reporting from the observer or through the vessel operators or vessel agents from the port of arrival. Upon receiving the arrival notice, the Observer Manager/Coordinator organizes Debriefer personnel at the port of arrival to carry out pre-debriefing and full debriefing for the observer.

PIRFO debriefing

The Observer Coordinator assigns a PIRFO certified Debriefer to carry out pre-debriefing at the port of arrival as soon as the port call notice is received. The Debriefer conducts a preliminary check on the observer regarding their wellbeing and for any critical incident that may require immediate attention from the authorities. The Debriefer also highlights any discrepancies on the data and provides feedback to the observer for correction. After the pre-debrief, the Debriefer arranges the venue and schedule the date and time for a full face-to-face pre-debrief to be carried out.

A PIRFO certified Debriefer to carry out the full face-to-face debriefing with the observer. The Debriefer prepares the necessary debriefing form and commence debriefing. The PIRFO debriefing form can be found at: (http://www.pirfo.org)

The PIRFO Debriefer evaluates the observer's performance using the PIRFO evaluation form and provides a written feedback for the observer if improvement is required. The PIRFO evaluation form can be found at (http://www.pirfo.org). The debriefed data score sheet of the observer is registered in a spreadsheet and uploaded to database afterwards. This includes the performance rating of that particular observer for that trip. The observer debriefing score determine how much the observer get paid their due fees. Category between 100% - 85% score get the maximum pay rate, 84% - 75% score gets the middle range and below 74% score get the minimal pay rate. The trip reconciliation sheet is compiled and forwarded to the finance to process the observer final pay.

Dealing with critical incidents

Observer critical incident reports in relation to the alleged violation reported by the observer is analysed and compiled during the face-to-face debriefing by the PIRFO certified Debriefer, and or the Critical Incident Analyst. The incident report is forwarded to the Observer Coordinator for noting and handed over to the Head of Fisheries Compliance and Enforcement for further analysis to ensure there are sufficient elements of evidence to proof the alleged violation. The alleged case is pursued with an investigation by the appropriate personnel. The Observer Coordinator follow up with the investigation team to ascertain the outcome of the case for record keeping purposes, and inform the observer concern on the case.

Conclusion

Only PIRFO ***certified debriefers*** trained to minimum regional certification standards can carry out debriefing. Certified national debriefers and PIRFO recognised staff from relevant supporting regional organisations may provide debriefing assistance if available when locally certified debriefers are otherwise unavailable.

Debriefing can be used to evaluate observer payment on the basis of data provision, data quality and promptness of submitting data. Payments to observers at the completion of a trip is not made until after debriefing is complete. The rate observers are paid reflects the amount of quality data that they produce rather than just the number of sea-days that they complete. Contract observers who fail to produce acceptable data after two or three rigorous debriefings are reconsidered for refresher trainings etc.

Observer programmes working under the PIRFO umbrella may choose to utilise this regional debriefing policy or to develop national policies that encompass the minimum guidelines that this policy describes. However, if developing a national policy, PIRFO programmes will accept an initial debriefing by certified debriefers of other programmes and can follow up with further debriefing according to their own policy under further arrangements made by the relevant programme. The PIRFO debriefing Policy can be found at (http://www.pirfo.org)

Finding the right tools for the job: the suite of monitoring approaches used to manage Alaskan fisheries

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Introduction

A variety of management regimes exist in Alaskan fisheries and each relies on a range of data sources and different suite of monitoring tools. Catch share programs are a fishery management tool that allocates a share of the fishery resource to individual fishermen or fishing cooperatives to harvest a fixed quantity of fish each year. As the programs have been developed, NOAA Fisheries has established several fishery-specific, comprehensive monitoring programs that vary due to differences in the designs of the management program, the data needed for management, and the characteristics of the fishery. Clarity in the desired objectives is essential and determines the appropriate monitoring approach.

Catch Monitoring Approaches

As fishery management programs have been developed in Alaska observers, electronic reporting, and electronic monitoring technologies have all been implemented and provide a variety tools that are used to help accomplish specific objectives (Table 1).

In open access fisheries electronic reporting of industry information on landings, production, and effort is required through elandings. Observer data is used to estimate total catch (retained and discarded catch) and the observers are deployed on a random selection of trips. In lieu of observer coverage, vessels that fish with fixed gear (longline or pot) can opt into the Electronic Monitoring (EM) pool and carry video systems.

Catch share programs have a variety of designs which reflect unique circumstances in each fishery and goals of the program, which include: meeting conservation goals, improving economic efficiency and/or flexibility, improving bycatch management, reducing excess capacity, eliminating derby fishing conditions, and improving safety. In general, catch share programs require a more intensive suite of monitoring tools for management. Allocations of exclusive harvest privilege can create increased incentive to misreport as compared to open-access fisheries and independent and verifiable data is important because quota share recipients are prohibited from exceeding their allocation. Transferable bycatch limits present additional challenges for accurate accounting because these species are not retained for sale.

Table 2 summarizes six catch share programs in Alaska and compares the suite of monitoring tools that have been implemented to achieve address monitoring objectives. The monitoring in the halibut and sablefish IFQ program is similar to open access fisheries and data from observers and EM are used for catch estimation. Trips are randomly selected for monitoring and vessels can opt-in to the EM pool and carry cameras instead of observers. A Prior Notification of Landing is an additional tool that enables NOAA Office of Law Enforcement the ability to monitor offloads.

The monitoring approaches for the five other catch share programs involve a broader suite of tools that depend on whether fish is processed on shore or at sea; fishing gear; the number of allocated species; and how transferable bycatch limits are accounted for (e.g. census versus sampling).

Conclusions

Complicated management approaches increase the demand for enhanced equipment, operational, and catch accounting requirements to ensure accurate accounting for allocated species, including bycatch. In particular, catch share programs usually require: near-real time access to data by agency and fishery participants; data that are not subject to wide variability on a day-to-day basis; and legally defensible information to hold quota holders accountable for staying within their quota allocations. When deciding which of monitoring tools are appropriate for a new program, NOAA Fisheries must balance considerations of cost, enforceability, timeliness of data available for management, and other agency resources required. A combination of observer data and a suite of electronic reporting and electronic monitoring tools meet these demands to accomplish sustainable management in Alaskan groundfish and halibut fisheries.

Table 1. Monitoring approaches used to manage the groundfish and halibut fisheries off Alaska.

Monitoring Approach	Description
Observer Coverage	**Partial Coverage-** Vessels in the partial coverage category log their trips and are randomly selected to carry an observer.
	Full Coverage- Observers are on the boat or in the processing plant for all of the trips and deliveries. In some cases, two observers may be required to ensure each haul or delivery can be sampled to estimate retained & discarded catch.
Electronic Monitoring (EM)	Fixed gear vessels can choose to be in the EM program instead of taking an observer. Trips are randomly selected for monitoring and the data is used for catch estimation.
Compliance Video Monitoring	**At-Sea Scales –** Video provides evidence of potential scale tampering; shows scale components and all areas where crew may adjust the scale.
	Bin Monitoring – Video monitors crew pre-sorting prior to observer sampling. Displays all areas where crew may be located inside the holding tank prior to observer sampling.
	Salmon Monitoring - Ensures observer can verify all salmon are counted to manage prohibited species catch limits. Includes a requirement to designate a salmon storage container. Displays all locations where sorting occurs and the storage container.
At-Sea Scales	Scales use motion compensation to weigh all catch at-sea to provide precise total catch estimates.
Catch Monitoring and Control Plan (CMCP)	**CMCP -** submitted to NOAA Fisheries by shoreside processor that describes how all catch delivered will be sorted and weighed to species within view of an observer.
	CMCP with Salmon Storage - Additional requirement in CMCPs to provide location to store salmon and describe how all salmon will be sorted and weighed within view of an observer.
	CMCP Specialist – NOAA Fisheries staff visits each shoreside processor during offloads to ensure accurate weighing and species identification.
Prior Notification of Landing (PNOL)	Vessels notify NOAA Fisheries prior to landing, to provide opportunity for enforcement to monitor the offload.
eLandings	Electronic reporting software to allow vessels and shoreside processors to submit mandatory reports of catch, production, and effort.

Table 2. Summary of six catch share programs in Alaska and the suite of monitoring tools used to manage the program.

Management Program	Vessel Count	Gear	Key Target Species	Monitoring Challenge/Objective	Suite of Monitoring Tools
Halibut and Sablefish Individual Fishing Quota (IFQ)	1,200	Longline	Halibut and sablefish	• Accounting for landed catch • Fleet-wide estimates of at-sea discards	• Partial Observer Coverage or EM • elandings • PNOL
American Fisheries Act (AFA)	102	Trawl	Pollock	Accounting for: • Allocated Pollock • Transferable Bycatch limits	Fish processing on shore: • Full observer coverage on vessels • 2 observers at plant • CMCP for salmon accounting • elandings Fish processing at sea: • At sea scales • Compliance video for scales and salmon accounting • Full observer coverage • elandings
Amendment 80	19	Trawl	Multi-species -- flatfish &	Accounting for: • Multiple Allocated Species	• At sea scales • Compliance video for scales and bin monitoring

			groundfish	• Transferable Bycatch limits	• Full observer coverage • elandings
Central Gulf of Alaska Rockfish Program	44	Trawl	Rockfish, Pacific cod, sablefish	Accounting for: • Multiple Allocated Species • Transferable Bycatch limits	Fish processing on shore: • Full observer coverage on vessels • CMCP Specialist • CMCP • elandings Fish processing at sea: • At sea scales • Compliance video for scales and bin monitoring • Full observer coverage • elandings
Bering Sea and Aleutian Islands Freezer Longline Voluntary Cooperative	28	Longline	Pacific cod	Accounting for: • Allocated Pacific cod • Bycatch limits	• At sea scales • Compliance video for scales • Full observer coverage • elandings

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Monitoring the compliance with Landing Obligation

C. Morgado, M. Santos, M. Nuevo

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The support of the implementation of the landing obligation is a priority to the European Fisheries Control Agency (EFCA) by conducting several activities to deter possible non-compliance and assess and monitor the level of compliance with the Landing Obligation. As from January 2019, the landing obligation requires all catches of regulated commercial species on-board to be landed and counted against quota. Undersized fish cannot be marketed for direct human consumption purposes. Catches are recorded as below (BMS – below minimum size) and above (LSC – legal size catch) the Minimum Conservation Reference Size. Discarding any of these catch component is an illegal activity, except for a few exemptions on *de minimis* and survivability, legally authorized.

In 2014, EFCA initiated a dedicated project – the Last Haul (LH), encompassed within the control and inspection effort and sea inspections, where catch composition have been collected with participation of Member State inspectors and assistance from EFCA staff in the field.

Data collected from the LH activities, because is verified, are use as reference data and compared with the catch composition declared in the logbook (not-verified). The methodologies used, assumes that the verified data is representative of the fleet segment with the same gear, mesh size and area of fishing activity. The verified data used is only the data collected when no illegal fishing activity, such as the use of illegal gear, was detected.

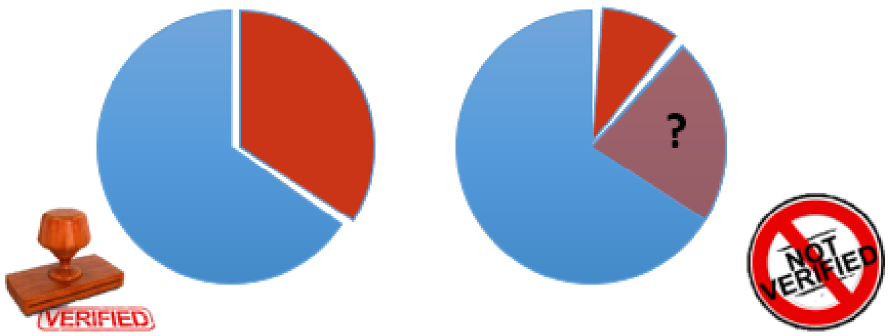

Figure 1. Representation of the methods used to estimate unreported discards on non-verified data based on verified data.

Three types of methods are used: a) estimation of BMS discards; b) estimation of LSC discards; c) estimation of discards independent of the size of the fish

<ins>Estimation of BMS discards</ins>: The estimated BMS rate (BMS / total catch) from the LH is compared with the recorded BMS in the logbook and the difference between the two data sets gives the actual level of estimated unreported discards.

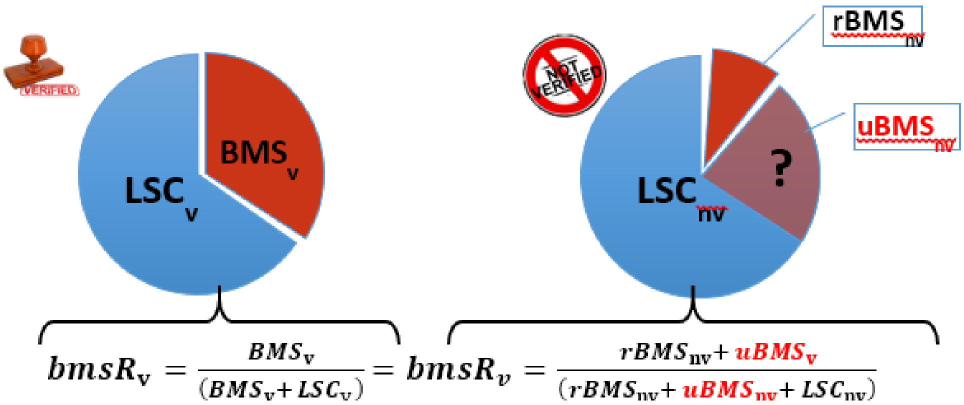

Figure 2. Representation of the method to estimate BMS discards from the LH data. BMS: bellow minimum size; LSC: legal size catch, which corresponds to above minimum size; v: verified data (LH); nv: non-verified data (logbook); bmsR: BMS ratio.

For cases where the illegal discarding occurs in the LSC component (i.e., high grading), EFCA uses the proportion of the grade size declared in the sales notes from vessels operating with Remote Electronic Monitoring system (REM) as reference data. The comparison of the grade size proportion from those vessels with the vessels operating without an REM system provides an indication of LSC discarded quantities. Vessels operating with REM may change their fishing behavior towards the avoidance of small size fish. Therefore, the estimates should be considered as minimum estimates. Grade size quantities collected during LH can also be considered reference data. However, the collection of LSC grade size is not collected routinely.

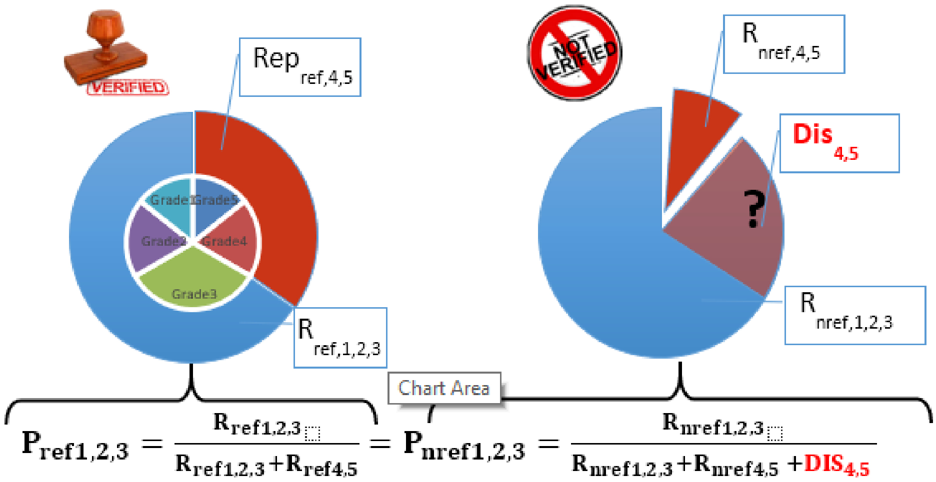

Figure 3. Representation of the method to estimate high grading (discards of legal size catch). $P_{ref1,2,3}$: proportion of grades 1, 2 and 3 of the total catch, from reference data (either vessels with a REM or grade size collected during LH). $P_{nref1,2,3}$: proportion of grades 1, 2 and 3 declared in the sales notes from vessels without REM. $R_{ref1,2,3}$: quantities of grades 1, 2 and 3 of the total catch, from reference data. $R_{nref1,2,3}$: quantities of grades 1, 2 and 3 declared in the sales notes. $R_{ref4,5}$: quantities of grades 4 and 5 of the total catch, from reference data. $R_{nref4,5}$: quantities of grades 4 and 5 declared in the sales notes; ref: reference data, either from vessels with a REM or grade size collected during LH; nref: non-reference data, sales notes from vessels without REM.

For some species / stocks discarding practices are independent of the size usually linked with low commercial value and /or quota exhaustion. If the reference data available do not have size composition information beyond the distinction of catches above and below the MCRS, the estimation of the discards could be based on species composition. Assuming a uniform species composition of the catch, within a given fleet segment, the catch data of two species (let's say species A and species B) collected from the LH could be used as reference data. The discard ratio of one species (species A) can be calculated if the catch of the other species (Species B) is known. It should also be noted that, although it is assumed that discarding is independent of fish size, it is likely that larger sizes will be retained more than smaller sizes. This aspect is not reflected since there is no size composition information in the reference data.

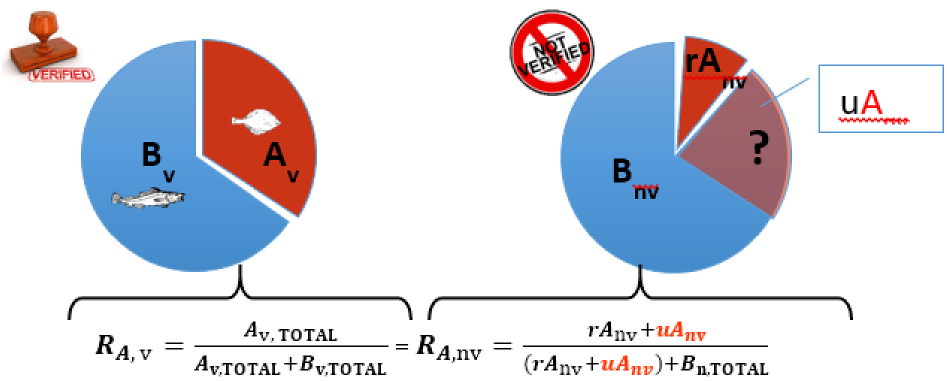

Figure 4. Representation of the method to estimate discard when there is no reference data with size composition. A: quantities of *Species A*; B: quantities of *Species B*: v: verified data (LH); nv: non-verified data (logbook). rA: reported catches of *Species A*; uA: un-reported catches of *Species A*.

The estimation of discards is conducted at fleet segment level (fishing trips from vessels with a specific gear, mesh size and with fishing operations in a specific area). The quality of the estimates depends in the case of reference data from LH on the number of LH per fleet segments and the heterogeneity of the catch. For the case of REM reference data, the quality of the estimates depends mostly on the deterrence effect of the REM. Currently, the reduce numbers of vessels with REM (vessels operating with CCTV cameras) is low, which limits the estimation of LSC discards.

The estimates of illegal discards based on the above mentioned data have been crucial as input data for the annual compliance risk assessment and for evaluation of compliance with the LO.

Electronic monitoring (EM) of small purse-seine vessel. Basic standards for monitoring fishing activities and catches

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<u>Introduction</u>

Fisheries management or assessment requires complete catch and bycatch information. Class 1-5 vessels (< 363 Mt of carrying capacity) fishing data provide basic catch information on target species, but information on tuna discards is unavailable and catch of non-target species can be incomplete or unavailable. Low quality/resolution data on catch of target and non-target species in the eastern Pacific Ocean (EPO) purse-seine fleets, including Class 1-5 vessels could compromise fishery management. In this regard, EM systems offer the possibility of providing solutions for some of these challenges.

The purpose of this project is to conduct a proof-of-concept EM study for the EPO Class 1-5 vessels. The types of data that can be reliably collected by EM aboard small purse-seine vessels will be evaluated in this project, and, if results are promising, the establishing of basic standards on EM data collecting. Up to date, analyses on implications for camera placement and vessel selection will be presented as previous steps for the EM data collection and comparison with observer data, which is currently in progress.

<u>Survey of vessel characteristics and fishing operations</u>

The purpose of the survey was: 1) Identify operational characteristics that may affect placement of EM equipment and data collection. 2) Provide data to help with selection of participating vessels. 3) Generate data to assist in development of a pilot EM sampling design. Several questions were consulted around four topics: Catch handling, operational characteristics of the vessel, FAD deployment, and vessel characteristics.

Survey results

A little more than half of the vessels (55%) have an accessible wet deck. Many of the vessels with accessible wet deck (93%) loaded wells with chutes. 71% of vessels without accessible wet deck load wells directly from the main deck. 70.2% of the vessels sort/remove species at brail. Most of the vessels (94%) keep the floating object (or FAD) inside the net when the encirclement is finished. The number of speed boats used may depend on the set type (e.g. Unassociated sets, using more than one speed boat = 78%). 70% of FAD deployments were made by hand around the stern-port area.

Implications for camera placement

Several areas were identifying for camera placement for data collection purposes (Figure 1): Area 1, for floating object presence/absence, for set type determination, and FAD deployment. Area 2, for FAD deployment, bycatch fate, discards, preliminary species identification and size composition. Area 3, for species identification and size composition, bycatch fate and discards. Area 4, for number of speed boats used in the set, FAD deployment, bycatch fate and discards. Area 5, for number of speed boats used in the set and FAD deployment. And for vessels with accessible deck: Area 6, and 7, for well identification, species identification and size composition.

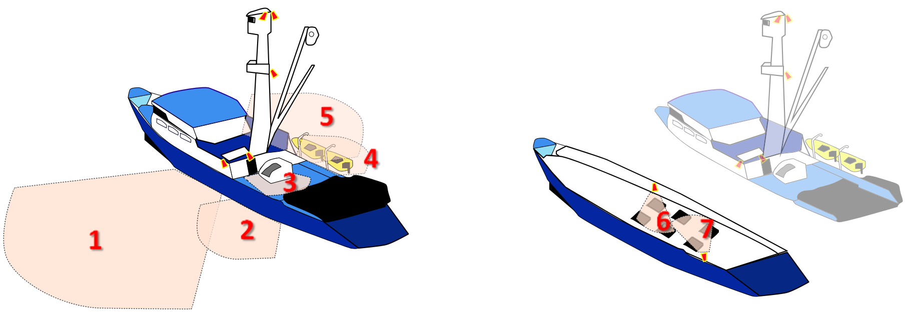

Figure 1. Implications for camera placement on board the tuna purse-seine vessel.

Identifying group of vessels for vessel selection

A hierarchical cluster analysis was used using the data provided by the survey. Four groups of vessels identified. Primary split based on use of chutes, accessibility of wet deck. Smaller splits based on other variables, e.g. group 4 contains vessels with largest vessel/brail capacity, higher crow's nest and more speed boats than other groups. Group 3 contains vessels with the smallest vessel/brail capacity, no speed boats, some without crow's nest.

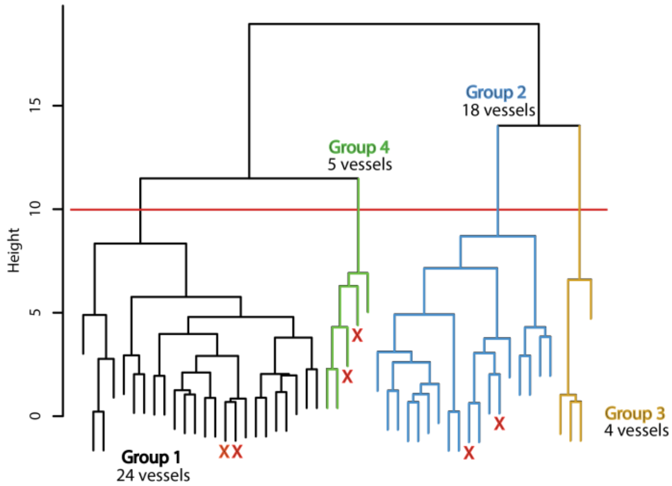

Figure 2. Hierarchical cluster analysis for selecting vessels for EM data collection.

Criteria for selecting vessels for EM data collection

Vessel large enough to safely carry an observer. With no logistical constrains. Choose two vessels from each cluster as close to each other as possible, one with video and the other EM still-image.

Acknowledgements**:** Our gratitude to the European Union for the financial support of this study.

THE EFFECTIVENESS OF FADs (*Fish Aggregating Devices*) FOR POLE AND LINE FISHERY IN BIOLOGICAL ASPECTS BASED IN BITUNG, INDONESIA

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Abstract
Pole and line fishery is one of important caught in fisheries industry. Beside it is famous for fully responsibility gear, also pole and line is primary gear in Bitung Indonesia for skipjack fisheries. Tuna is highly migratory, that's why the management has managed by RFMOs (Regional Fisheries Management Orgnizations). Bitung is one of landing site for tunas in Western Central Pacific Ocean (WCPO) area. The fishing activities for pole and line, it's used auxiliary fishing such as : Fish Aggregating Devices (FADs), even though sometimes they fishing in fish schooling. This purpose if the research is to assess the effectiveness of FADs for pole and line based on biological aspects. The methodology is measurement for length and weight of skipjack and yellowfin tuna during fishing in FADs and Fish Schooling. The data was collected by observer on board from January – May 2015 at Sinar Bahari Vessel in

Bitung, Indonesia. The result showed that pole and line fisheries depend on life bait, it means that no life bait equal not fishing. The effectivity of the FAD's was not significant because the pole and line catch the tuna by undersize (Lc < Lm), beside the undersize issue the pole and line also catch the bycatch.

Introduction

Tuna has managed by Regional Fisheries Management Organizations (RMFOs), because tunas are highly migratory species. Indonesia has been the member of RFMO's since 2004 (www.wcpfc.int) and is adhered to supply information on the total catch of each fishing vessel following RFMO's regulations. In this case, Bitung is one of landing sites for data collection in Western Central Pacific Ocean (WCPO) area. There are two ways for fishing activity in pole and line: the usage of Fish Aggregating Devices (FAD) and fish schooling. FAD is an auxiliary tool/material for fishing activities. The objective of this paper is to assess the effectivity of FAD in pole and line fishery from biological aspect, in terms of length at first capture and length of maturity, based in Bitung, Indonesia.

Methods

Data collection comes from primary and secondary data. The data was collected by observer on board at KM. Sinar Bahari 02 from January – May 2015. The fishing vessel based in Bitung, North of Sulawesi, Indonesia. The total random sample are SKJ 577 and YFT 299. It has measured by length and weight.

Table 1. Data Summary

Number	Month	FG	Life Bait	Total of life bait	number of fishers	Total Catch	Avarage of life bait	Avarage of total catch	SST (celcius)
1	January	Maluku Sea	*Stelophorus spp*	534.6	9	3990	39.4	443.33	28-29.5
2	February	Maluku Sea	*Stelophorus heterolubus*	2403	23	14055	104.43	611.09	28 - 29.5
			Mixed	1371	7	9784	195.86	139.71	
3	March	Maluku Sea	*Stelophorus heterolubus*	34.2	3	366	11.4	122	28 - 30
			Mixed	129.6	4	2473	32.4	618.25	
			Decapterus spp	470	14	6523	33.57	465.93	
4	April	Sulawesi Sea	*Stelophorus spp*	298.8	9	4700	33.2	522.22	28 - 29
5	May	Sulawesi Sea	*Stelophorus spp*	857	8	12307	107.13	1538.38	28 - 29

The estimation for the length of first capture is used the relationship of length-weight graph. In addition, the distribution of length "X" axis and total catch with cumulative percentage was estimated by "Y" axis. The analyzes instead to assess the number of Lc (length at first capture). Where, it is taking from the line between "X" by 50% at "Y" (Bevorton & Holt (1957) *in* Sparre & Venema, 1999). To assess the number of Lc able to use the graph for the relationship of length-weight "X" axis with the total catch is in cumulative percentage "Y" axis, as of released the S curve. The number of Lc (number L50%) taken by X axis and Y axis (Spare and Venema, 1999) :

$$S\ Lest \ = \frac{1}{1 + \exp\ (S1 \ - \ S2^{*}L)}$$

$$Ln \ = \begin{bmatrix} \frac{1}{Sl} & 1 \end{bmatrix} = \ S1 - S2^{*}\ L$$

$$L50\% \ = \frac{S1}{S2}$$

Where: SL = Standard Length

S1 = *Intercept* (a)

S2 = *Slope* (b)
x = Mid
y = Ln [1/SL – 1]

<u>Results</u>

Total Catch

The total catch in pole and line fishery was composed of 56% skipjack tuna and 44% of yellowfin tuna. The total catch by kg was showed that skipjack tuna almost 23 ton during 5 months of fishing.

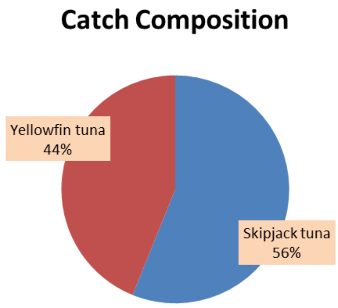

Figure 1. Catch Composition

The information about the fishing ground were plotting by GIS / ArcGIS 10.1 version. The result showed that the fishing activity using the FAD's mostly in the north of Sulawesi (green dot), but the fishing activities by fishing school mostly in the south of Sulawesi (red dot).

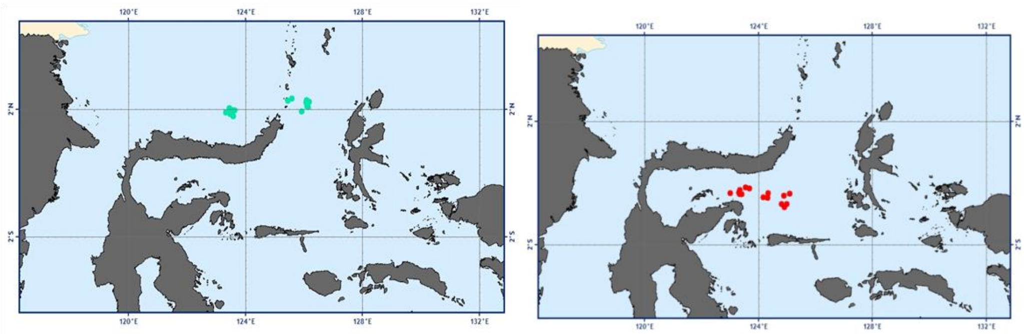

Figure 2. Fishing Ground

The measurement of the length is to estimate the growth rate (Effendie,A. 1979). According to Sparre and Venema (1999), the relationship between length and weight was implemented, where is $W(i) = q * L(i)^b$ where is ; $W(i)$ Weight (kg), $L(i)$ Length (cm) q and b are constant. The data sample was collected by observer from January until May 2015. A total of 577 skipjack tuna and 299 yellowfin tuna were recorded. According to the sample, the equation is $W(i) = q * L(i)^b$. The result showed that number of the exponent for SKJ and YFT is same $b \geq 3$, with the equation is $W(SKJ) = 0{,}002005\ L(SKJ)^{3{,}5468}$ and $W(YFT) = 0{,}0068\ L(YFT)^{3.2244}$, from the equation above the result showed that the growth of length and weight for SKJ and YFT are positive algometric. The analyses for t-table (SKJ) is $t\ total = 7{,}640 \geq t - table = 3{,}307$, and t-table (YFT) is $t\ total = 2{,}789 \geq t - table = 2{,}754$ with number of r is 95% for both of them, that means the distribution of the data is statistical significant.

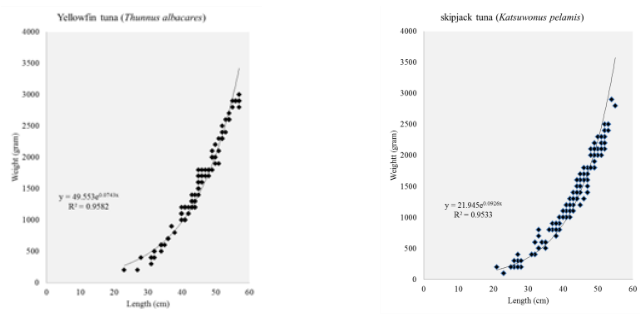

Figure 3. The Relationship between length and weight

The length frequency showed that skipjack tuna dominated by size < 46 - 50 cmFL and yellowfin tuna dominated by size < 41 – 47 cmFL.

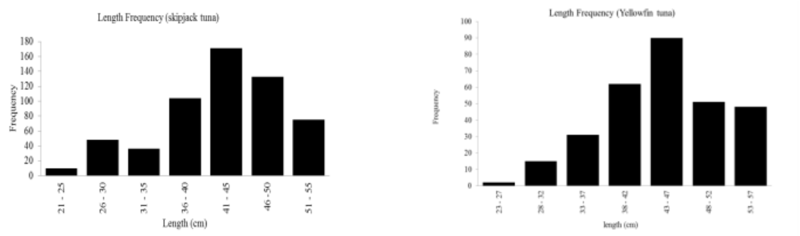

Figure 4. Graph of Length Distribution

Length at First Capture (*Lc*)

According to Sparee and Venema (1999), they inform that the estimated for the length at first capture was implemented by the graph of length and weight relationship. The graph 4 showed that the distribution of the length (X) and total of catch showed by estimation cumulative (Y). The length at first capture was analyzed by the relationship line at X axis is 50% in Y axis. The result showed that length at first capture (*Lc*) for skipjack tuna is 43,36 cmFL and the length at first capture (*Lc*) for yellowfin tuna is 45,81cmFL.

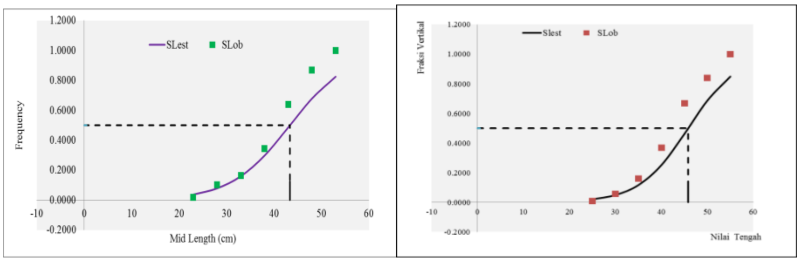

Figure 5. Length at First Capture SKJ and YFT

Conclusion

Most pole and line fisheries depend on life bait, it means that no life bait equal not fishing. The effectivity of the FAD's was not significant because the pole and line catch the tuna by undersize (Lc < Lm), beside the undersize issue the pole and line also catch the bycatch.

Acknowledgment

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Fisheries Data Collection - The Norwegian way

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Norway has one of the world's leading fisheries sectors in terms of both production and sustainable management (Pitcher *et al*., 2009). The Norwegian fishing fleet is both large and diverse, with more than 5500 commercial fishing vessels under 15m and a further 470 vessels up to 81m in length, landing over 2 million tonnes annually (Directorate of Fisheries 2017). Most of these catches are landed domestically in one of the more than 800 registered landing sites spread along the entire coastline of Norway (83 000km), including fjords and islands. The size, diversity and geographical complexity of the Norwegian fisheries create many challenges to monitoring and collecting data for research and management. So how does Norway do it?

The Institute of Marine Research (IMR) is responsible for providing scientific advice on the sustainable management of Norway's fish-stocks and other marine resources. IMR has a long history of cooperation with the Directorate of Fisheries, the Norwegian Coastguard and the
fishing industry itself for monitoring the fisheries and collecting the necessary data for giving scientific advice. Here we present the main sources for catch statistics and catch sampling that have resulted from this cooperation.

There are three main types of catch statistics reported by the industry to the Directorate of Fisheries, which are then shared with IMR.

<u>Landing Tickets and Sales Notes</u>
Norway has one of the most comprehensive systems for reporting landings and processing the data. Catches must be first declared at sea in the vessel's logbook, which for most vessels is done electronically using ERS or the Coastal fisheries App. All catch landings in

Norway are organized through one of several fisheries sales organizations. The catches are weighed at the time of landing and registered in the sales note. Routine controls check for differences in the catch weight registered in the logbooks and landed catch weight, that could indicate misreporting. The system is set up to deliver landing tickets and sales notes that form the basis for the deducing catches taken from quotas on a vessel level. This system gives both management and scientists a continuous overview of caught, landed, and sold catch.

Coastal Fisheries App

Since 2016, smaller vessels (under 15 meters) that are not subjected to ERS regulations, are required to report catch results using a purposely designed Application (App) that runs on devices like smartphones and tablets. This App represents the main channel of data collection for smaller vessels. All the data is stored on databases in the Directorate of Fisheries. Vessel owners and captains register their phone number with the Directorate of Fisheries and then they download the free App to the device of their choosing. At the end of fishing trip, and before entering to port, they make a landing declaration that consists of a total weight estimation of the catch by species. There are plans to include more data and reports in the App. The Directorate of Fisheries use the data from the Coastal fisheries App actively to monitor and control the fisheries, but IMR currently do not use the data. However, the data is expected in the future to play an important role in improving research of the coastal fisheries in Norway.

Electronic Catch Logbook (ERS)

Norway has since late 1970's received logbooks from commercial fishing vessels. In 2008 the system was digitalized so that catches are now reported electronically while the vessel is at sea. The electronic catch logbooks (ERS) are supplied commercially, with the vessel owner covering the costs of buying and operating the software. This system provides the Directorate of Fisheries with information on each catch taken from the annual quotas by commercial vessels, reporting estimates weights by species with information on effort, gear size and type, geographic position, date and time of the catch. Each vessel on a fishing trip has to declare the result of the catch every day before midnight and before landing. This system allows the fisheries management organizations to continuously follow the fisheries as it unfolds. The data is also shared with the Coastguard for control purposes and the IMR for use in stock assessments, researching the biological effects of fisheries regulations and monitoring changes in the fisheries.

Due to the diversity of the fishing fleet and fisheries Norway has had to adopt different methods for biological sampling of catches, both at sea and at landing sites. Here are the main methods that are used for covering sampling of the commercially most important fisheries.

The Reference Fleet

The Reference Fleet is a small group of Norwegian fishing vessels that provide IMR with detailed information about their fishing activity and catches on a regular basis. The sampling and data management procedures are similar to the system used on board IMR's research vessels, but instead of scientists it is the fishermen themselves that sample their own catches and provide detailed information about discards and bycatch. Data is used for management purposes including stock assessment, total catch estimates, monitoring regulation effects and following developments in the fisheries and ecosystems.

Port Sampling of Landed Catches

60% of the Norwegian catches of North East Arctic Cod (Norway's commercially most important demersal fish-stock) is taken by the coastal sector of the fishing fleet. The large proportion of catches are landed round (un-gutted and head-on) and thus can be sampled portside for taking otoliths and other biological samples that are necessary for determining age, sex, maturity and other parameters that are necessary for stock assessment. IMR employ a vessel to transport scientists between the many landing sites spread along the coastline in order to carry out the necessary sampling of not only cod, but also other commercially important demersal species. The scientists sample on average 400 catches annually from 50 landing sites.

Inspections by the Coastguard and fishing authorities

The Directorate of Fisheries and the Coastguard are responsible for monitoring and controlling fishing activity in Norwegian waters. Both have a team of inspectors inspecting catches at sea and, in the case of the Directorate of Fisheries, also at landing sites. Much of the data collected during inspections, such as length of fishes in the catch, is also useful for the IMR. Therefore, the IMR has established a good cooperation with both agencies for sharing information and extra sampling when required. However, since the inspections are planned with regards to monitoring illegal activities and in particular undersize fish in catches, there is a risk of bias when using the data to represent catches from the whole fishery.

Structured Catch Sampling in the Pelagic Sector

Age-distribution in catches together with data on the quality (tonnes) of fish caught, is of particular importance for stock-assessment and reducing uncertainty in quota advice. In the pelagic sector, this sampling process is largely done by the fishermen themselves in consultation with IMR. When requested, fishing vessels take a sample, which is immediately frozen and delivered to the fish processing industries that send the samples to IMR for analysis. Several fish processors also take samples when requested after the catches are landed.

Since January 2018 the IMR, in cooperation with the industry and the Directorate of Fisheries, has begun trialing a new system for sampling herring catches. The aim is to optimize sampling. By law all catches must be reported daily in the electronic catch logbook system. These catches are automatically entered in the "herring lottery" to be randomly selected for sampling. If a catch is selected the fishermen receives an automatic reply to take a herring sample for IMR. The selection is based on statistical procedures in order to optimize the sampling process.

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Sampling on board the Portuguese purse seine fleet

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Introduction

For more than 15 years, the Portuguese Institute for Sea and Atmosphere, I. P. (IPMA, IP) has been running an observer program on board fishing vessels within the framework of the European Commission Data Collection Regulation (PNAB/EU-DCF - Programa Nacional de Amostragem Biológica/EU-Data Collection Framework). Since late 2005, the observer program initiated in the purse seine fishery, where IPMA's observers collect data on board the fleet along the Portuguese coast, particularly regarding activity pattern, catch and landing compositions, slipping and discards at sea.

Methods

Observed trips were carried out using a standard protocol (Feijó et al. 2012). Between 2005 and 2008 36 trips were allocated in to 3 fishing areas. Starting in 2009, 24 trips per year were allocated taking into account both geographical distribution of the fishing areas and the quarterly distribution of landings in the previous year. For each trip, observers recorded among other parameters the total trip time, time spent searching, fishing and steaming; depth, coordinates and amount of fishing sets and the composition of the catch.

Results

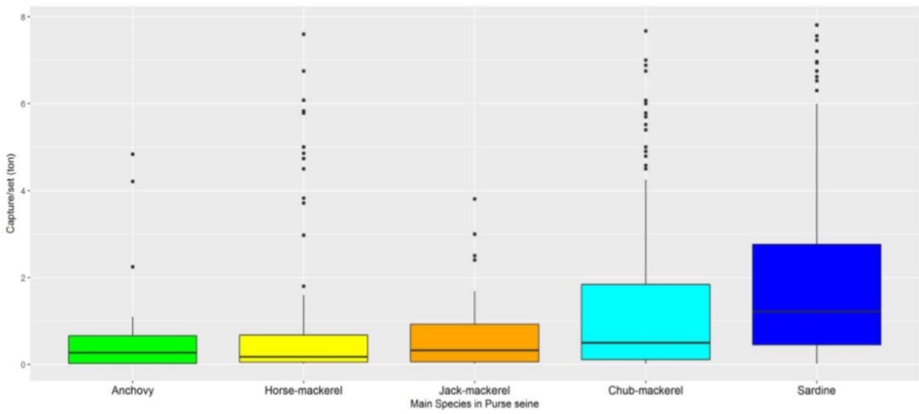
Since 2005, 22 observers monitored 69 fishing vessels (≈ 50% of the purse-seine fleet and less than 0.5% of landing trips per year) operating in 15 ports along the Portuguese coast (Table 1).

Table 1: Summary of observed purse-seine trips between 2005 and 2016.

			mean							
Area	N Trips	N Fishing sets	N set/trip	depth (m)	capture/trip (ton)	capture/set (ton)	search (h)	fishing (h)	steaming (h)	duration (h)
NW	112	134	1.51	38.00	7.94	2.49	4.82	1.92	1.73	8.91
SW	104	134	1.59	40.00	3.95	1.44	2.91	1.96	2.85	8.52
S	66	66	1.36	34.42	4.18	1.37	3.15	2.19	2.22	8.29
Total	282	334	1.48	37.58	5.60	1.83	3.64	2.03	2.24	8.57

Observers recorded short trips (2h–20h. Mean duration of a trip is around 8.5 hours (sd=±3.3h) with a large part of the trip consisting in searching and fishing (Table 1). This two operations are the main reason for the trips became larger, since the sardine reduction ban (since 2014) looking for other species schools. For example, in the NW, fishermen spend more time searching for schools. For some species, the catch for set had reduced, the yield have increased. The catch is mainly pelagic fish like sardine and chub-mackerel (Fig. 1). A purse-seine trip could have 0-4 sets, between 14-121 m deep (Table 1).

Fig. 1: Main species captured (in tons) in the observed purse-seine trips between 2005 and 2016.



<u>Conclusions</u>

This ongoing work in DCF/PNAB made possible the description and update of the knowledge about operational activities, fleet behaviour and captures. Even though the monitoring program has covered more than half of the purse-seine fleet, it is still necessary to assess the optimal trip sampling coverage, which currently sits at 0.5%. Regardless, this program is the key to understand several trends of the Portuguese purse-seine fishery and it's vital to assist its management. In Portugal, the purse-seine fleet is the most cooperative fleet within the DCF/PNAB, providing all conditions to optimal data collection.

<u>Acknowledgements</u>

We thank all the skippers and crewmembers of the purse seiners and Producer organizations, for contributing with their knowledge and welcoming all the observers onboard. This work has been done under the European Commission's Data Collection Framework - PNAB/EU-DCF Programa Nacional de Amostragem Biológica (Reg. EC 2008/199). We thank Alberto Rocha and Andreia Silva for their help with R.

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Use of fishing monitoring data in two marine protected areas of Brazil

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<u>Introduction</u>

Currently, brazilian fishing involves more than one million fishermen, generating more than 800 tons of fish per year (MPA, 2011). Fishing monitoring aims to generate statistical information to subsidize studies of the activity performance, evaluating stocks in operation, identifying potential alternative fishing grounds and conducting various sectoral analyzes aimed at the sustainable management of resources (Aragão, 2006). Monitoring guides decision-making and help in implementation of rules to maintain the minimum resource levels for survival of fishing (Policansky, 2001). The present work presents experiences of monitoring use subsiziding fisheries management in two marine protect areas in São Paulo e Paraná States, Brazil.

Methodology

Research was carried out on coast of São Paulo and Paraná States, Brazil (Figure 1), involving two Protect Areas: 1) Marine Environmental Protected Area of São Paulo coast (APAMLS, São Paulo) and 2) Currais Island National Park (PARNA Currais, Paraná).

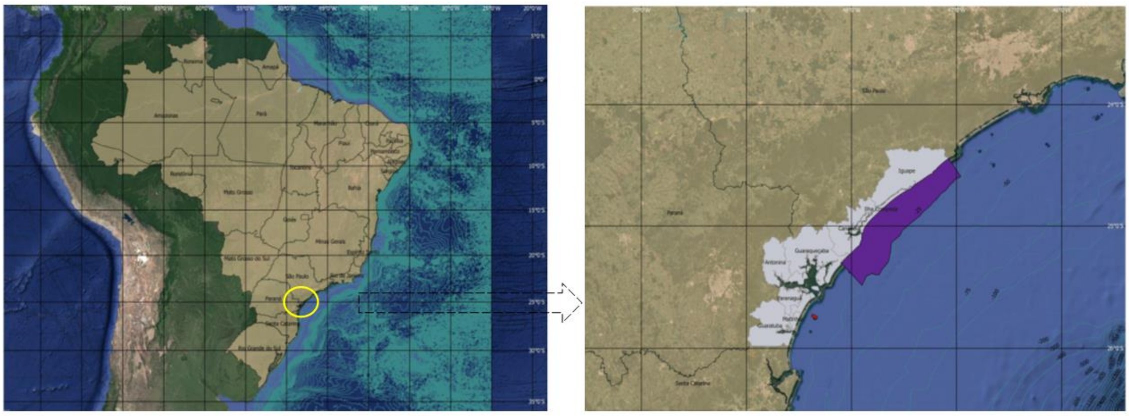

Figure 1. Map with research area (yellow circle). Red: PARNA Currais e Purple: APAMLS.

Data were obtained through the Monitoring Program of the São Paulo Fisheries Activity and the Paraná Fisheries Monitoring Project at the Laboratory of Reference, Unit in Statistical Control of Marine Fisheries Production of the Fisheries Institute - SAA/SP, during the period from 1997 to 2017. Fishing data collection occurred as described by Mendonça & Cordeiro (2010), Carneiro *et al.* (2017); Jankowsky *et al.* (2017). Monitoring used the census method to register all fisheries on a daily at landing points and/or in fishing communities, recording information of the fisheries. It was used the database ProPesqWEB (Ávila-da-Silva *et al.*, 1999) for storage of fishery information and spreadsheet for analyzes. In the APAMLS, São Paulo, was analysed the process to building norms for gillnet fishing and in the PARNA Currais, Paraná, the work investigated compliance with rules implemented by the Commitment Term.

Results and Discussion

APAMLS is a protect area what aimed sustainable development, allowing the orderly use of natural resources. During the period from 2010 to 2015, the management of the activity was analyzed using fishery data from fishery monitoring, which presented the number of productive units (vessels or fishermen), production, fishing effort and areas, and characteristics of fishing equipment (Table 1). After the presentation of this diagnosis to fishermen, there was an discussion and was builded a proposed management to gillnet fishery, what was published in 2016.

Table 1. Characteristics of gillnets in south cost of São Paulo State. (I) Industrial fishing; (A) Artisanal fishing.

	Network tipe	
	Bottom-set	Surface
Mesh size	(I) 70 a 180 mm (A) 40 a 330 mm	(I) 100 a 180 mm (A) 40 a 330 mm
Average lenght (± s)	(I) 6060 m (± 1511 m) (A) 218 m (± 131 m)	(I) 3095 m (± 1400 m) (A) 320 m (± 189 m)
Average height (± s)	(I) 2,3 m (± 0,5 m) (A) 3,0 m (± 0,5 m)	(I) 9,0 m (± 1,7 m) (A) 8,5 m (± 1,0 m)
% of fishermen using gillnets	(I) 88,6% (A) 64,2%	(I) 2,3% (A) 10,1%
Target species	(I) *Micropogonias furnieri, Macrodon ancylodon* (A) *Micropogonias furnieri,* Ariidae*, Lobotes surinamensis, Macrodon ancylodon*	(I) *Oligoplites spp., Scomberomorus brasiliensis* (A) *Mugil lisa, Oligoplites spp., Mugil curema*

In PARNA Currais, fishing is forbidden. Managers, researchers and fishermen representatives implemented an experimental proposal to fishing in PARNA, a Commitment Term (CT). CT allowed fishing with gillnet for three genus: *Mugil*, *Scomberomorus* and *Oligoplites* during the period from May to August 2017. 70 boats were allowed to fishing, recognizing the traditional right of artisanal fishers. Monitoring measured CT efficiency, analyzing fishing inside and outside PARNA, considering dynamics of fisheries, production, fishing areas and effort. It was concluded that there was low incidence of irregular vessels, 87% of the licensed vessels used the permitted equipment and 80% of fisheries were of permitted species.

In these two cases, it is observed that coast of São Paulo and Paraná present the conditions to make the fishery management more adequate and precise due to the monitoring information. Information is the basis of good management, being behind all stages of fisheries manager, encompassing formulation policy, management plans, process evaluation, updating policy and continuity of the process, being one of the main tools for fisheries management (Berkes *et al.,* 2006; Ruffino, 2008; Seixas *et al.*, 2011). To promote sustainable activities in protected areas, accurate and continuous information is essential. In addition to information, the articulation and involvement of users makes the process legitimate and applicable, reducing conflicts between sectors.

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Abstracts of presentations that did not provide Extended Abstracts

Underlying reasons and requirements for monitoring fisheries

Sam Rauch

United States NOAA Fisheries

The National Oceanic and Atmospheric Administration’s National Marine Fisheries Service (NMFS or NOAA Fisheries) has supported federal fishery observer programs since the early 1970’s, beginning with monitoring marine mammal interactions in the eastern Pacific tuna purse-seine fisheries and catch data on foreign vessels fishing in U.S. waters. As Deputy Assistant Administrator of the agency since 2006, Sam Rauch will address how over the last forty years, the NMFS observer programs have developed from the early stages of compliance monitoring to advanced technological data collection for the conservation of marine resources and sustainable fisheries.

Currently, NMFS utilizes fishery observers and at-sea monitors to collect scientific data from commercial fishing vessels, catcher processor vessels, motherships and shore-side processing facilities throughout all five of the U.S. fisheries management regions. Each regional program collects fisheries and biological data to meet management requirements in the Magnuson- Stevens Fishery Conservation and Management Act. By collaborating with the six regional Science Centers and eight Fisheries Management Councils, our observer programs deploy more than 900 observers in 46 U.S. commercial fisheries.

The scientific data observers collect in these fisheries supports the NMFS mission of maintaining sustainable commercial fisheries. The successful evolution of these federal observer programs and their collaboration with the eight regional fishery management councils is reflected in the economic growth of our nation’s commercial fisheries

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Observer coverage on the foreign flagged pelagic longline tuna vessels operating within the South African EEZ

Sekiwe Mbande and Victor Ngcongo

Department of Agriculture, Forestry and Fisheries. Republic of South Africa

Due to its geographic location, South Africa’s Exclusive Economic Zone (EEZ) covers both the Atlantic and Indian Oceans. South Africa is therefore a signatory to all relevant tuna Regional Fisheries Management Organisations (RFMO) including International Commission for Conservation of Atlantic Tunas (ICCAT), Indian Ocean Tuna Commission (IOTC), etc. These RFMOs require that signatory states have observer coverage in their tuna fishing activities for sustainable management
of fish stocks. In addition, observer programs provide a cost effective means of collecting fisheries data that is valuable to scientists, managers and resource users. Since the South African tuna fishing right holders are allowed to use foreign flagged vessels to catch their allocation in a joint venture effort, 100% scientific observer coverage is one of the mandatory permit conditions. This condition has helped to address most compliance and management issues while observers were collecting scientific data. This initiative has further limited possibilities of Illegal Unreported and Unregulated (IUU) fishing and improved monitoring of Protected, Endangered or Threatened (PET) species. This presentation will discuss unique aspects of the observer program in South Africa i.e. 100% observer coverage on the foreign flagged pelagic longline tuna vessels, initial challenges experienced in the implementation of the program, how they were overcome and other lessons learned. The important role played by non-governmental conservation agencies will be highlighted.

Challenges with the implementation of ER and EM in the Solomon Islands fisheries monitoring

Derrick Tagosia

The Ministry of Fisheries and Marine Resources, Solomon Is

Electronic Reporting (ER) is the process of entering and sending of fisheries information electronically over satellite or the internet to a database where the information is stored. E-reporting includes data entry and transmission of standardised vessel logsheet and observer data from the boat at sea or from the port of landing. Electronic monitoring (EM) is the process of collecting fisheries data by using electronic means that can include cameras and gear sensors. These are three different reporting systems in place on few longline (LL) vessels fishing in the Solomon Islands. While these three different monitoring systems complements each other, there can be data inconsistency challenges. This paper highlights these challenges.

Data inconsistency between these monitoring tools can for example be that a vessel e-reports having caught ten yellow fin tunas, the observer e-reports that eight yellow fin tunas were caught and an electronic monitoring analyst declares that twelve yellow fin tunas were caught. However, in most cases, catch enumeration data inconsistencies concern non-target species that have little or no commercial interest (e.g. pelagic sting rays and lancet fishes).

Inconsistencies between data sets can arise from: (i) the vessel's captain unfamiliarity with a new e-reporting system or unfamiliarity with catch reporting obligations (i.e. they may not think that reporting non target or discarded species is important), (ii) the on-board observer may not be able to observe the entire catch (i.e. there are times when they are resting), and (iii) an EM analyst may not be able to report catches with precision if the quality of the EM records is poor (i.e. when the lens are obstructed by water droplets or physical objects).

Being able to monitor the catch activities of a vessel using these three different methods is best process towards ensuring an efficient catch verification system as well as providing data for scientific studies (e.g. stock assessment modelling). However, data inconsistencies pose the challenge of deciding which data set should be regarded as the most accurate data.

The trial of new technologies to monitor the fishing activities of longline vessels fishing in the Solomon Islands began in 2014 and there is a need for continuous research and development to ensure they can be implemented with the greatest efficiency. In this regards, the support from the fishing industry and ensuring efficient training on the use of these new tools is essential.

Use of Observer Data in Rebuilding Overfished Species: A Port Specific Example

Steve Samana

Alaskan Observer Inc.

With the re-authorization of the Magnuson-Stevenson Act in 1996, an amendment to focus on rebuilding overfished fisheries was put into place. Consequently, ten groundfish stocks of the United States West Coast were declared overfished. Using observer data as a tool, an unprecedented listing as rebuilt for four fish has occurred ahead of fisheries estimates. Petrale sole (Eopsetta jordani) and canary rockfish (Sebastes pinniger) were rebuilt in 2015; darkblotched rockfish (Sebastes crameri) and bocaccio rockfish (Sebastes paucispinis) were rebuilt in 2017. Fisheries managers use myriad data sources to asses stocks: landings from processing facilities, government stock assessments and observer program data are three of the most reliable. The port of Fort Bragg, California serves as an excellent reference harbor to look in detail how observer data contributed to the rebuilding of afore mentioned stocks. Fort Bragg has a large, intergenerational fishing community that has seen the decline, turn around and eventual rebuilding of the stocks. With the exception of S. pinniger, the rebuilding fish were managed simultaneously as important commercial fisheries in the area. Thus the port was greatly affected by the declaration and contributed greatly to the data collected. In the following talk, I am going to focus on how data collected by observers from the Fort Bragg area was used by managers to declare the four stocks as rebuilt, thus maintaining compliance with the Magnuson-Stevenson Act. Furthermore, I will discuss the outlook for the two remaining overfished rockfish on the West Coast, cowcod (Sebastes levis) and yelloweye rockfish (Sebastes ruberrimus) and how; once again, Fort Bragg is a key focal port to examine the progress.

REKREA – Monitoring and inclusion of Danish marine recreational fisheries data in stock assessment

Hans Jakob Olesen, Troels Kjeldbjerg, Frank I. Hansen, Stig Pedersen, Marie Storr-Paulsen, Josianne G. Støttrup, Karin Stubgaard, Mads Christoffersen, Niels Jepsen, Casper Gundelund and Christian Skov

DTU Aqua - National Institute of Aquatic Resources, Denmark

Monitoring of marine recreational fisheries has become increasingly important for several stocks as both scientists and fisheries managers have recognized that the potential impact of recreational fishery on a stock can be significant. However, fisheries managers often lack information on the recreational fishery, as reporting of catches is not mandatory as for commercial fisheries. This implies that a part of the total catch and biological information is missing from the stock assessment. This lack of information on recreational catches can become critical e.g., when a decreasing fish stock is targeted by both recreational and commercial fishery and the stock assessment only includes data from the commercial fishery. The Danish marine recreational fishery (DMRF) is currently being monitored by an off-site interview/questionnaire based recall survey providing catch estimates for different species.

This type of data collection relying on fishermen and anglers voluntarily self-reporting catches is typical for artisanal and recreational fisheries where official landing data is unavailable. The DMRF sampling frame is a list of valid annual license holders for either passive gear fishing (gillnets and fyke nets) or angling proving information on catches of species included in the DCMAP program i.e. cod (Gadus morhua), eel (Anguilla Anguilla), seatrout (Salmo trutta) and salmon (Salmo salar). These catch estimates are however believed to be biased as respondents are likely to be more avid anglers than non-respondents resulting in an overestimation of the total recreational catch. As stock assessment is developing and incorporating recreational catch data more detailed information is needed. We therefore include probability based on-site survey methods to improve the accuracy of recreational catch estimates, minimize the biases and provide biological samples. The REKREA project is believed to provide guidelines for the sampling of the most important species in the DMRF and help decision takers to decide on a suitable management strategies for the future DMRF. The REKREA project, aims to test, develop and combine different types of surveys on four species important to the Danish marine recreational fishery (DMRF) and to implement the collected data where relevant in stock assessments.

Towards Stewardship: Beyond the Basics and How Do We Go Further

Vanessa J. Tuttle, Jason Jannot, Tom Good

NOAA Fisheries

Well-established observer programs have been turning the crank collecting haul and catch data for decades. Observer programs and data collections evolve and change over time, but how do we take data collection the next step and encourage greater stewardship in the industry? Can we smooth the path and identify conservation needs through careful examination of existing data? Can we encourage and guide fisheries towards sustainability by co-leading the way? The At-Sea Hake Observer Program is leading the charge by monitoring seabird trawl cable strikes. We are assessing injury and mortality from these interactions in the Pacific hake processing fleet off the U.S. West Coast. The challenge with cable strikes is they were only infrequently and opportunistically observed in the past, meaning this mortality was both cryptic in nature and under-reported. Taking a collaborative approach with industry, we hope to reduce seabird injury and mortality through the development of successful bycatch mitigation strategies. We began with a new, randomized data collection aimed at monitoring trawl cables and recording seabird strikes to document the interactions. This helped reveal the scope of the problem and indicated which species are most vulnerable to cable strikes. We then convened a workshop bringing fishers, scientists and managers together to brainstorm potential mitigation strategies. Feasible and practical mitigation strategies are at the heart of success for this project. The workshop group identified and agreed upon five distinct strategies, keeping in mind that there must be real potential to field test these strategies. Finally, we hope to push towards sea trials of the most promising strategies. Ultimately, the goal is to develop a catalog of best practices that will result in reduced injury and mortality of seabirds in trawl fisheries. We hope that a strong, transparent, collaborative process will move us towards improved stewardship, with relative ease.

Fostering Growth Between Science and Compliance

Matthew Walia

NOAA Fisheries, USA

Fishery monitoring decisions are based on the specific country, fishery and data goals. The United States has pursued a nation-wide approach to marine fisheries conservation by enacting the Magnuson-Stevens Fishery Conservation and Management Act in 1976. The Magnuson-Stevens Fishery Conservation and Management Act has complex goals aimed to prevent overfishing, rebuild overfished stocks, increase long-term economic and social benefits, and ensure a safe and sustainable seafood supply. Based on the 2016 annual Status of Stocks report released by National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries), 92% of all managed stocks/stock complexes were within their annual catch limits (474 total stocks/stock complexes). Economic, biological and environmental information taken for management purposes by observers play a critical role in stock determinations. Specifically, in the United States Southeast Region, observers collect data through three observer programs based out of Texas and two cities in Florida. A large variety of species are monitored from shrimp to reef fish to highly migratory species; targeted by multiple gear types. NOAA Fisheries Office of Law Enforcement (OLE) has worked with the observer programs closely since 2013 when reporting procedures were enhanced, and these recently updated reporting measures have improved the cooperation and communication between the two divisions; leading to more accurate management decisions, as well as observer safety. Observers collect data needed for management decisions and in turn, need to be confidant that they can do so effectively and safely. NOAA OLE considers observer program concerns a high priority and the reporting measures enacted in the three Southeast programs will be discussed, as well as examples of observer collected data leading to better compliance and safety measures. Compliance issues are broken into five categories with varying degrees of severity under each category; gear violations, handling prohibitions, retention limits, spatial violations and observer compliance/harassment. A successful rapport of law enforcement and the observer community is essential in obtaining stewardship and conservation goals.

Project CATCH – how to bring coastal angling tourism and nature conservation together

Jakub Skorupski and Aneta Kozłowska

Green Federation "GAIA", University of Szczecin

The project entitled “Coastal Angling Tourism – a development chance for the South Baltic Region” (CATCH), financed under the EU INTERREG South Baltic Programme, is being implemented in order to increase the capability of coastal communities to establish sustainable coastal angling tourism, deliver improved measures for touristic providers and to combine all new knowledge in an innovative information and knowledge platform on coastal angling tourism. The CATCH project promotes, develop and improve methods of sustainable coastal angling tourism, to make it environmentally friendly and nature-oriented. Coastal angling tourism offers a unique development chance for the Baltic Sea Region, especially for less developed coastal regions, but its development must go hand in hand with respecting the natural heritage, especially in deltas and estuarine areas, which are particularly ecologically fragile (eg Odra Delta and Szczecin Lagoon in Poland). The CATCH project emphasizes the importance of recreational angling within the resource-efficient blue growth in the South Baltic Region, increase the capability of coastal communities to establish sustainable angling tourism, deliver improved measures for touristic providers and combines all new knowledge in an innovative information and knowledge platform on coastal angling tourism. The key factor in sustainable recreational fishery is knowledge of the size and condition of fish populations valuable from an angling point of view. All sustainable angling practices should be based on this knowledge. Here, a review of the current state of coastal angling tourism in the South Baltic Region, in the context of sustainable, assisted by monitoring use of coastal waters is presented. The CATCH project is implemented by the international consortium, composed of the following institutions: University of Rostock (Germany), EUCC - Coastal Union Germany (Germany), Green Federation „GAJA” (Poland), Nida Culture and Tourism Information Centre "Agila„ (Lithuania), Klaipėda University (Lithuania), Municipality of Vordingborg (Denmark).

Observing a Commercial Jig Fishery targeting Yellowtail Rockfish in California, USA

Kevin Stockmann

Alaskan Observers Inc. Observer, USA

One of NOAA Fisheries’ guiding principles is to conserve and manage fishery resources to realize their full economic potential while also preventing overfishing and ensuring rebuilding of overfished stocks.Yellowtail rockfish and Chilipepper rockfish are abundant, currently underused, species ranging the Pacific Coast of North America. These species, and several similar rockfishes, were historically harvested with vertical hook and line gear (also known as mid-water jig gear) featuring artificial lures known as shrimp flies.

In 2002, NOAA Fisheries established area closures in the form of Rockfish Conservation Areas (RCAs) because seven overfished rockfish species were determined to be in danger of collapse. Take of all rockfish within depth-restricted areas was prohibited across vast areas of the continental shelf. The newly created RCA eliminated most harvest opportunities for Yellowtail and Chilipepper Rockfish.NOAA's Exempted Fisheries Permit (EFP) program encourages innovation by allowing fishers to design and test methods of targeting underused species while avoiding species that are rebuilding. Commercial fishers in California are currently evaluating a promising gear modification, a minimum 5-fathom breakaway low-test leader located between the lowest hook and the weight. If this gear is proven capable of harvesting the abundant midwater species while avoiding the overfished bottom dwellers, then the fishery's optimum yield could be enhanced. A goal of this collaborative research is to determine whether the modified gear selects for target species with enough specificity that fishing opportunities could be re-established where rebuilding species are known to occur below the target species. Fishery observers play an essential role in this research.

This experimental fishery includes the requirement for 100% observer coverage, a common feature of EFPs. In addition to documenting fishing location and specific gear configurations, CPUE, and catch composition, observers record the specific hook position on the vertical gear where each fish is caught. Observers also record the length, weight, sex, and release method of all discarded priority rockfish species and collect otoliths from all Yelloweye, Cowcod and Canary rockfishes for aging studies. These long-lived species are late-maturing and this observer-collected biological data helps with life history studies and population recovery modeling.

Analysis of observer data from the first two years of the EFP showed it may be possible to harvest target species with minimal impacts to rebuilding species. In 2017, this EFP was extended for two years and additional vessels are approved to participate. Electronic monitoring is being considered to supplement observer coverage.

Session 2. Industry engagement with monitoring

Leader: Lisa Borges

While fisheries monitoring programs can lead to tensions between regulators and industry, there are a number of examples where industry has become actively engaged in monitoring, leading to results that are better than those obtained when either group operates in isolation. This session explored these collaborations to identify their essential elements, benefits and weaknesses.

Oral Presentations - Extended Abstracts

Independent On-Board Observers Scheme (IOOS) …and a successful story of cooperation between Industry and Science in Scotland

Elena Balestri

Scottish Fishermen's Federation, UK

The Scottish Fishermen Federation (SFF) is an umbrella including 8 associations covering from the smallest inshore boats to the most modern offshore pelagic vessels. It represents the interest of a large number of Scottish Fishermen which, all together hold almost the 90% of total Scottish Quota (65% of UK's total). The Federation preserve and promote the collective interest of constituent fishermen's associations and represent them in national and international fora.

In 2008, following the revision of the Cod Recovery Plan, EU regulations allowed member countries to manage days at sea for their own vessel. A Conservation Credit Steering Group (CCSG) was formed to assist in the management of those days. The group was composed by representatives from the Government, Scientific Institutions, Environmental NGO and Fishing Industry). Measures were introduced to regulate under the CRP, including real-time closures and selectivity devices on fishing gear. Financed by the Scottish Government and the EFF the Independent On-Board Observer Scheme was created by the Scottish Fishermen's Federation to back up with solid data the engagement of some fishermen in extra conservation measures to "buy back" days at sea. Additional aims were to provide independent fisheries information on various Scottish fisheries, support and validate industry initiatives, trial the effectiveness and viability of the new selective gears and provide scientific data that could feed into the end of the year negotiation process.

The IOOS evolved through various phases to reach its actual structure and commitment. As presented in two of the previous International Fisheries Observer and Monitoring Conference (Chile 2013 and San Diego 2016) the project faced and overcame various challenges managing to gain the trust of the scientific community and becoming a fundamental player in the data collection scenario.

At its 10th anniversary (and 6th phase), counting on a staff of 6 Observers, with either scientific or practical fishing background, a project co-ordinator and a project manager, the Scheme proves to have the capability to cope with various work streams, maintaining the flexibility to provide support to any Industry/Science related project requiring a strong data backup. It now copes with the following main activities:

- Providing enhanced data for stock assessment as part of the joint Marine Scotland Science (MSS)/SFF Observer Scheme
- Participating in the industry/science anglerfish survey (SIAMISS) which underpins the science advice on fishing opportunities
- Supporting industry led initiatives such as the Gear Innovation and Technology Advisory Group (GITAG) to test selective methods of fishing to address potential problems relating to the Landings Obligation (for whitefish and *Nephrops* fisheries)

- Providing practical advice and support for science / industry projects which require direct observations and data collection at sea on commercial vessels (e.g. commissioned under Fisheries Innovation Scotland or Fishing Industry Science Alliance)

- Providing observer coverage and sampling for a scientific monitoring fishery for herring in ICES Division 6a, 7b and 7c as advised by ICES

- Supporting the science / industry Clyde Inshore Demersal Survey
- Maintaining the flexibility to support any industry/ science related project requiring a strong data backup

As a result of the robust and continuous training the observers are undergoing in order to meet high level of competence and efficiency, the usage of data gathered has been widened and those collected as part of the joint SFF/MSS scheme (60% of the total) now contribute to the ICES stock assessment.

In providing evidences to support various initiatives contributing towards the economic and sustainable viability of Scottish fishing vessels as they maximise their fishing opportunities within the framework of the Common Fisheries Policy (CFP), the IOOS has received ongoing support from the Scottish Government. As stated above, funding for this initiative was initially provided by EFF (European Fisheries Fund) and, more recently, by EMFF (European Maritime and Fisheries Fund) guaranteeing a continuity of 10 years of work. With the exit of UK from Europe and from the influence of the CFP a new challenge lies ahead: while the need of data collection to feed the stock assessment or back up any other science/industry project will certainly continue, it is not clear yet how the data collection projects will be funded. What is certain is that with the level of coverage and quality gained by IOOS, its discontinuation would certainly represent a big issue for both the scientific and fishing communities in Scotland.

Can Observer Program Outreach and Collaboration with Industry Stakeholders Lead to Beneficial Outcomes for All? A Case Study of the Central Gulf of Alaska Rockfish Program Trawlers.

Alex Perry

NOAA NMFS Fisheries Monitoring and Analysis Division, North Pacific Observer Program

<u>Background and Problem Statement</u>

The Central Gulf of Alaska (GOA) Rockfish Program was implemented in 2012. It is a Limited Access Privilege Program managed under quota shares, requiring 100% observer coverage. The fleet consists of trawlers, primarily catcher vessels, with some catcher processors participating. The fishery is prosecuted using both non-pelagic and pelagic trawl nets. In this fishery Chinook salmon is managed under a federal Prohibited Species Catch (PSC) cap and is caught as bycatch. If that PSC cap is reached, the fishery is closed by regulation. The PSC cap was caught in 2015, but the PSC closure coincided with the date of the regulatory closure. In 2015, updated regulations mandated that all trawl catcher vessels in the Gulf of Alaska retain all salmon for delivery to shoreside processors. However, because the vessels may—and do—actively sort at sea, observer at-sea species composition samples are the sole source of data used in catch accounting and mortality estimation in that fishery. Stakeholders (members of the fishing community) have voiced concern that extrapolations from at-sea observer samples may result in high levels of uncertainty and variability, particularly from the more rarely-encountered species, such as Chinook salmon. The fleet comprises small trawl vessels with dynamic and challenging sampling platforms, and thus observers have previously been limited in their ability to apply best-practices in random sampling. Citing safety issues and the need to move fish quickly, this fleet *previously* encouraged observers to collect a single, non-random ("opportunistic") sample, and then get off of the deck and out of the way. Because of stakeholders' concern over observer at-sea sample extrapolations, the industry desires to improve catch accounting for Chinook. The Observer Program staff in Kodiak (Alex Perry and Sarah Neumeyer) were tasked to initiate an outreach effort to improve observer sample data collection to address this concern.

<u>Methods</u>

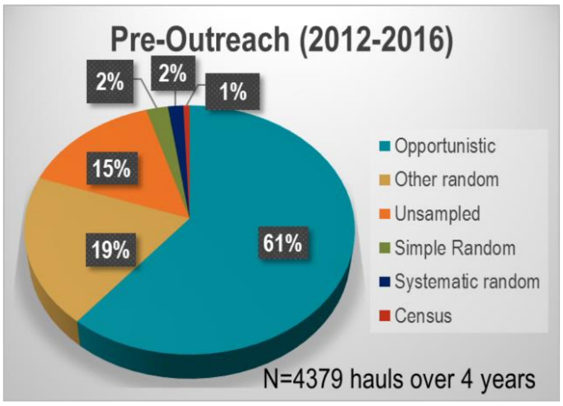
In 2016 and 2017, the National Marine Fisheries Service (NMFS), in collaboration with industry stakeholders (vessel owners, captains, and Alaska Groundfish Data Bank), initiated efforts to improve catch estimation via observer sampling in the Central GOA rockfish fleet by: 1) attempting to increase observer sample size and number of samples, and 2) improving observers' ability to optimize random sampling techniques available to them. Achieving stakeholder buy-in was essential to successfully implementing these efforts. Educating the fleet that the North Pacific Observer Program's efforts sought to improve all catch accounting, including Chinook salmon mortality estimation, achieved that buy-in from the fleet. The fleet was encouraged to assist observers in collecting their samples by improving observer access to fish and sample storage space. Outreach and education was conducted both with the fleet and with observers. Methods included: 1) presentations to the Kodiak Rockfish catcher vessel trawl fleet at biannual trawl fleet meetings; 2) an educational packet written by Kodiak Observer Program staff comprising: an Agency outreach letter explaining the Observer Program's outreach efforts, an informational page to instruct observers about the outreach, a sample design flow chart specific to this fleet to assist observers in designing random samples, and a post-trip questionnaire; 3) observer training of new sample design methods starting in 2016 (where sample units are evenly divisible into observer catch estimates); 4) in office instruction to observers and post-trip interviews (to discuss how sampling went); and 5) conducting on-vessel pre-cruise meetings with the vessel owners/captains/crew, Observer Program Kodiak field staff, and observers.

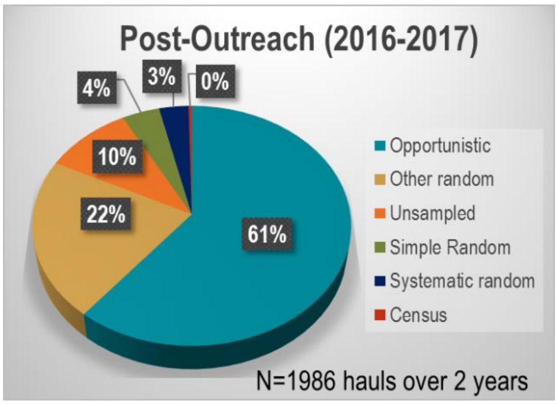
This presentation looks at observer sample data from 2012-2015, and compares them to observer data in 2016 and 2017, using the following metrics: 1) sample size, 2) sample design and randomization, and 3) number of samples, all on a per-haul basis. These three metrics were selected as the best indicators of the level of potential success of the outreach efforts. If improvements in average sample sizes per haul, randomization of sampling, and sample numbers were made, this may potentially gauge the level of success of the outreach efforts.

<u>Results and Discussion</u>

Average Sample Size: Somewhat surprisingly, average total sample size per haul remained unchanged between the pre-outreach years (2012-2015) and the post-outreach years (2016-2017). The average sample size pre-outreach was 229 kgs per haul, and post-outreach average sample sizes were also 229kgs per haul.

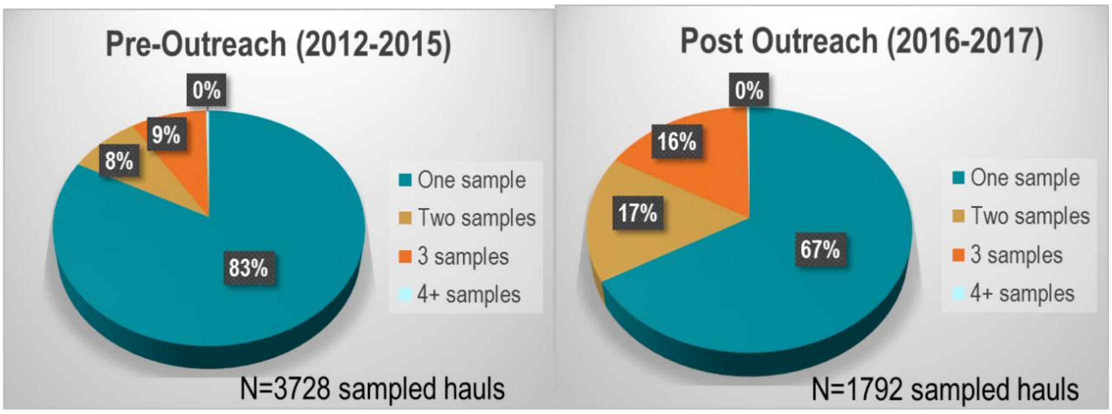
Sample Design and Randomization: sample designs are 1) opportunistic (meaning no attempt was made to randomize the collection of the sample); 2) other random (contains an element of randomization to the collection, but the entire population is not available to the observer); 3) simple random; 4) systematic random (random samples dispersed evenly throughout the haul spatially or temporally), and 5) census (all catch sampled). Unsampled hauls were also summarized.





Opportunistic samples remained unchanged at 61% of sampled hauls. Combining randomly sampled hauls showed a 5% increase in overall randomly sampled hauls, and this corresponded to an equal (5%) decline in unsampled hauls. This is certainly demonstrative of progress, but still leaves room for future improvements.

Number of Samples per Haul:



The number of hauls that had a single sample dropped from 83% to 67%. Hauls with multiple samples nearly doubled from 17% to 33%. Hauls with 3 or more samples likewise nearly doubled, going from 9% to 16%. It should be noted that more samples taken throughout the population have a better potential for mitigating over-representation of Chinook numbers, as they tend to be caught in schools. While this is a marked improvement post-outreach, this, too, leaves room for improvement.

Conclusions and Future Directions

The results lend strength to the hypothesis that the outreach efforts were generally successful. The measured success comes in large part from collaboration with the industry. Getting their buy-in and engagement took, and continues to take, ongoing outreach efforts. Persuading fishers that working with our staff and observers collaboratively can be beneficial to the Industry, the fisheries managers, and the observers by improving data collection methods was and is essential to garnering this collaboration. Shifting both fishers' and observers' mentality can take time. Though some vessels remain resistant to pre-cruise meetings and allowing observers increased access to gather samples and store the samples, by and large the Central GOA Rockfish fleet was and remains very accommodating of this change. There is still room for improvement; Kodiak staff continues to encourage the fleet and the observers to take advantage of on-vessel pre-cruise meetings to optimize vessel-specific random sampling, and observers are encouraged to discuss how sampling went with Kodiak Observer Program after their trips.

By showing that sample numbers per haul and sample design randomization improved overall in the Rockfish trawl fishery, likely as a result of these outreach efforts, this study can be used to demonstrate that engaging the industry in monitoring can lead to improved data collection, to the mutual benefit of managers and fishers alike.

There is a current collaborative research project being conducted at the processing plants in Kodiak, AK, for the Central GOA Rockfish fishery. The project is a collaboration between NOAA fisheries, FishNext Research LLC, Alaska Groundfish Data Bank, and the Industry. It is examining the potential to sample for all delivered salmon to improve Chinook mortality enumeration at the land-based processing plants, using both plant samplers and Electronic Monitoring tools. Regulatory changes may result from this project through NMFS and the North Pacific Fishery Management Council process.

Using scientific observer data to validate pelagic self-sampling data

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The pelagic freezer-trawler fleet (PFA) has been carrying out a self-sampling program on the freezer-trawler fleet since 2015, within the northeast Atlantic, West Africa and the South Pacific. The pelagic freezer-trawler fisheries are characterized by a high level of sampling being carried out for commercial purposes. The self-sampling programme expanded on the ongoing sampling programme by standardizing the sampling methodology and the recording formats. During self-sampled trips, the crew member will generally take a random sample of around 25 kg from the catch of all or most hauls, separate them into the different species and assess the species composition per haul. Several vessels will also measure the length compositions of each of the subsamples by species. During some of the self-sampled trips, the vessel was also joined by a scientific observer. For those trips the species and length compositions from the scientific observer have been compared to the self-sampling data.

The data set consisted of 16 trips in the Northeast Atlantic and 8 trips in the South Pacific over the years 2015 to 2017 where both self-sampling was carried out and where a scientific observer was on board. Unfortunately, for the Northeast Atlantic only three of the self-sampled trips carried out length sampling, the others only carried out the haul-by-haul species compositions.

In the analysis we focussed on a comparison of length compositions per trip. In many of the trips we found that the relative length frequencies per species were very similar (Figure 1). However, we also found for a limited number of trips, notably in the Northeast Atlantic where there were substantial differences between the self-sampling and the scientific observers (Figure 2). While it has not been possible yet to investigate the reasons for these differences (because the haul by haul data from the observer program was not yet available for this analysis), these differences may point to some methodological issues in either the self-sampling or the observer program. This will be further investigated.

We think that using observer data to validate self-sampling data may achieve an important benefit for the quality of the catch data that is used for stock assessment. Self-sampling, because it has a higher spatio-temporal coverage, can provide a more realistic of the overall length compositions during the whole fishing season (see Figure 3 for a comparison of self-sampling covering all trips and the observer program covering a more limited number of trips). On the other hand, the observer program can provide more in-depth information on the biological properties of the catch (length, age, maturity, sex). Finally, the comparison of self-sampling trips of scientific observer trips has a great potential in validating not just the self-sampling but also the scientific observer protocols because it allows, for the first time, a repeated observation of the same phenomenon that is normally very difficult to validate.

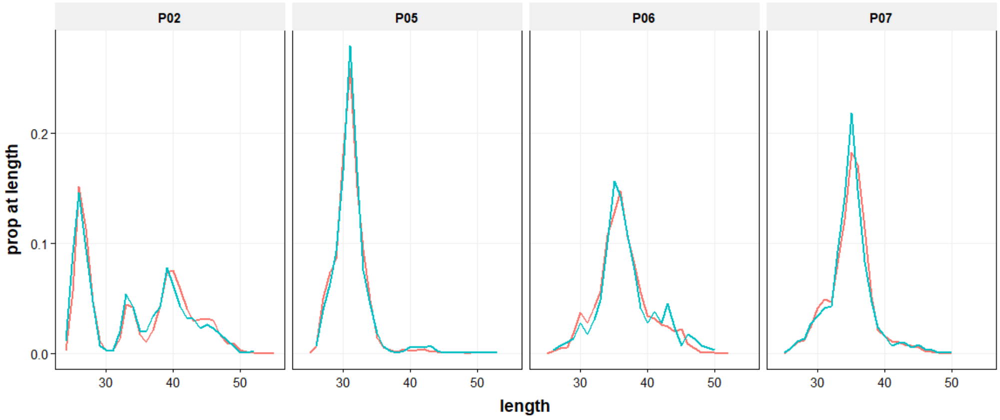

Figure 1 Proportion at length of Jack Mackerel (Trachurus murphyi) estimated from self-sampling (green line) and by scientific observers (red line). Each panel denotes a trip.

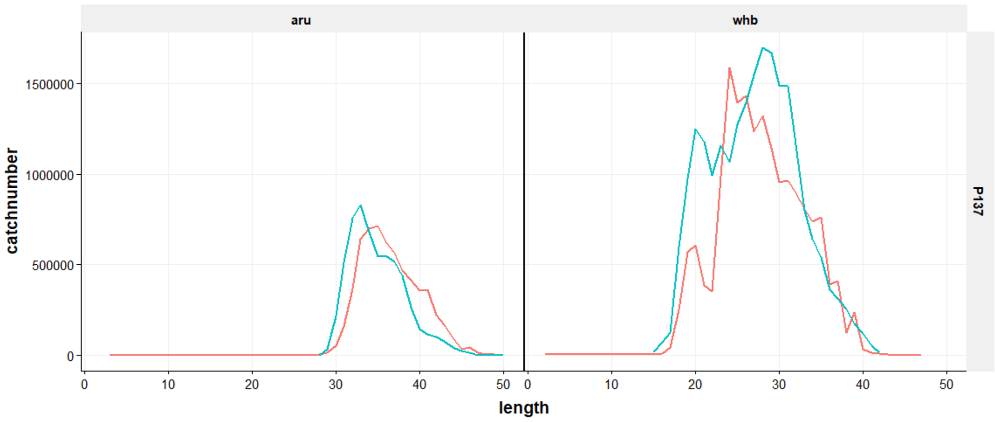

Figure 2 Raised length compositions of Greater Silver smalt (Argentina silus, ARU) and Blue whiting (Micromesistius poutassou, WHB) estimated from self-sampling (green line) and by scientific observers (red line) during trip P137.

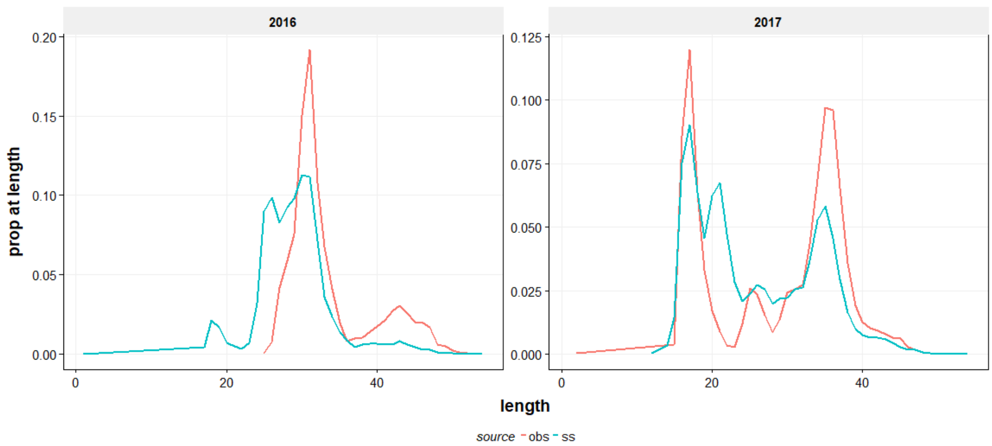

Figure 3 Proportions at length by year for Jack mackerel (Trachurus murphyi, CJM) estimated from self-sampling (green line) and by scientific observers (red line). The differences in proportions at length are caused by a difference in coverage of fishing grounds and seasons.

Derelict Crab Trap Removal from Fishing Grounds - a collaboration between industry and management to use EM data in new ways

Joan Drinkwin[1], Kyle Antonelis[1], Amanda Barney[2]

[1]Natural Resources Consultants,
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The Dungeness crab (*Cancer magister*) fishery is an important economic driver in British Columbia (BC), Canada, representing 31% of the value of the province's wild shellfish products. Preliminary estimates of the 2015 British Columbia landed value for crab is $54.8 million. The commercial Dungeness crab fishery in BC is divided into seven management/license areas. The Area A commercial fishery is the largest in British Columbia, generally landing over 1/3 of the commercially allocated Dungeness crabs in the province. In addition to commercial fishery, the Haida Nation exercises its First Nations Food, Social and Ceremonial (FSC) harvest rights and recreational crab fishing occurs in Area A. The total number of commercial traps that can be fished in Area A is 35,000 with the number of crab traps per commercial vessel dependent on the vessel's length. Approximately 60% of the Area A commercial crab fishers are members of the Area A Crab Association, which represents them in a variety of forums.

In the early 2000s, the Area A fleet pushed for, and paid for, the first electronic monitoring systems in BC's crab fishery complete with video cameras and gear tracking technology. These systems not only allowed the fleet to eliminate issues of gear theft and tampering, it also provided harvesters and fisheries managers a way to monitor fleet and vessel trap allocations, soak times and location. Along with this EM technology, the Area A crab fleet has also been running a charter each spring in which commercial vessels and crews are hired and trained to collected data on crab moult timing so that their fishery closes when the male crab are most vulnerable and does not reopen until they are safe and marketable. During this yearly fishery closure the charter vessel does 1-5 days of gear clean-up throughout their fishing grounds using data points on lost or abandoned gear collected by skippers or by the EM systems.

Lost crab traps are a recognized problem for the Area A crab fishery (see Figure 1.). Data from 2003 through 2013 indicates that between 6% and 10% of traps are lost each year. In 2013, 2,533 traps were reported lost. Trap loss is generally due to severe weather and sea conditions, and traps are usually lost when they are moved away from the location of deployment by a combination of heavy winds, currents and large swells, after which the fisher cannot relocate them. The buoys of these lost traps can be visible on the water surface or they might be submerged, with lines still attached. Lost crab traps can cause safety, liability, economic, and environmental impacts. Lost traps in Area A cause conflicts with other fisheries, in particular with salmon trollers and with groundfish trawlers.

In 2016, as secretariat of the Global ghost Gear Initiative, World Animal Protection (WAP) hired Natural Resource Consultants (NRC) to coordinate a lost trap retrieval project in close collaboration with the Area A Crab Association, Ecotrust Canada (monitoring service provider) and with participation from DFO. The project had three goals: to trial a more systematic and harvester-led approach to collecting lost traps; to better document the potential negative impacts of lost traps to harvest revenue; and to return lost traps to harvesters.

The derelict gear removal day was organized in one part of Area A: McIntyre Bay. McIntyre Bay was chosen because it is also an area with considerable use by the Haida Nation for Food, Social and Ceremonial harvesting and is used by other recreational and commercial fisheries, such as salmon trollers.

Lost crab trap removal operations were conducted on June 3, 2017. The gear removal day included two commercial crab vessels and crews participating along with staff from WAP, NRC and DFO). A total of 49 lost Dungeness crab traps were removed from McIntyre Bay (Figure 1). The gear removal day included two commercial crab vessels and crews participating along with staff from WAP, NRC and DFO). All traps were from the commercial Dungeness crab fishery, rather than the FSC or recreational fishery. In addition to the traps, 1,275 fathoms of vertical line were removed equaling 2.33 km. Total weight of traps removed was approximately 2,205 kilograms, or 2.205 metric tons. Traps were removed from water depths ranging from 3 to 26.2 fathoms. Average water depth from which traps were removed was 14.6 fathoms.

The success of this one-day removal and the long-standing success of the Area A charter and EM programs are due to the local knowledge and involvement of the Area A crab harvesters. It also helped maintain the engagement of the harvesters with federal regulators and First Nation leaders and demonstrated the use of EM data beyond compliance monitoring.

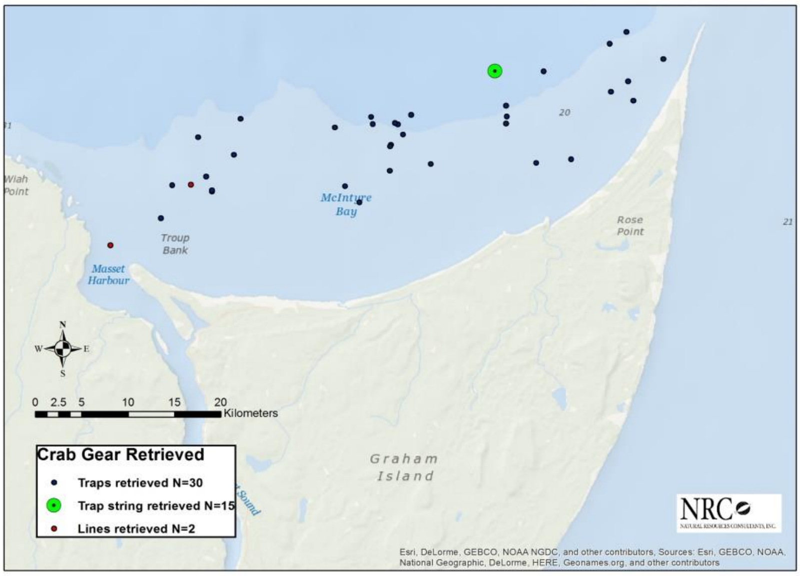


Figure 1. Locations of retrieved crabbing gear, McIntyre Bay, June 4, 2017

Open Discussion Session

Q. – Crabs is of a common interest to Indian Ocean, so could you elaborate on which crab you were referring to and its life cycle? Does the opening of the fishery depend of the data from industry or does it comes from legislation?
A – Canada - I was referring to dungeness crabs (Cancer magister), common crab species. Juvenile moult 2/3 times in a season, adults moult every year, but they may also moult only once every two years, males and females moult at different times, as males need a hard shell and a female soft shell to mate. May/June moult and 6-8 weeks the shell is hardened and therefore they can be harvested and fishery opens usually in July. Fishery is closed by federal law if there is no testing between March 21-1 August +-4-5 weeks either side of the window. Industry does the testing to close the fishery, and one vessel and sample the crabs in 75 traps in 5-10 locations to determine if the shell is safe to open the fishery again.

Q –In CCAMLR seabirds bycatch is statistically quite rare event but when you extrapolate to a fleet it may be very large number that requires some sensitivity analysis. Is salmon bycatch statistically rare and if so how do you account for the extrapolation numbers, and how the numbers control the closing of the fishery? And if its required to retain all salmon caught could the vessels not put the fish aside for the observers to verify their catch?
A – USA - Yes it's a rare caught species, maybe around 12.000 salmon allowed to be caught yearly by around 40-45 vessels. But this one of the reason why we are now looking for a new method for sampling: shore sampling. A new collaborative research project is going on with NOAA, the observers programme and the Alaska GDFN research group to examine this. Because fishers are required to retain 100% of caught salmon, we are looking to shore side sampling to remove the need to any extrapolation. In 2015, there was an event where an extrapolation number resulted in a closure of the fishery, but because it happened simultaneously to the regulatory closure, it did not impact the fishery, but it did raised industry concerns on the variance of the extrapolation numbers. There might be a need for a regulatory change to allow for the numbers of salmon recorded at the plant to be used to management. Industry is still allowed to do some level of sorting at sea, and thus it still requires an observer to watch if they are not discarding any salmon. In some fleets they are required to put salmon aside for the observer to record it. But there is still the need for regulatory change to address the sorting at sea, but shore side sampling is what is being looked at the moment.

Q – It seems there is already a sophisticated industry reporting regime already in place in the fishery but I wonder if EM has been considered to replace observers to verify the data collected by industry?
A – The Netherlands - Yes, we have been trialling a system with EM and its working. But with the present European legislation on monitoring, the fishery is hesitant to adopt EM as a mechanism. It was the first time we made this comparison between EM and the observers programme and we have already learned a lot.

Q – How essential you think high tech tools, such as EM and RFID tags, are for gear removal programmes? There is a big concern on entanglement of marine mammals in crab gear, but most vessels do not have EM and do not used RFID tags. Can this programme be adapted to fisheries that have different sets of data or do you really need EM or RFID tags?

A - Canada – EM has been used in one fishery in Washington, you can do it without the RFID *tags with logbooks or electronic logbooks with "geostamp" where you should retrieve the tag, you also don't need to go with full EM, as integrating VMS system with RFID tags allows individual trap identification in a very inexpensive way. With the concern around marine mammal entanglement there is new inexpensive industry friendly technology available, because there is economic utility for fisher not to lose their gear, saving money in avoiding losing as much gear and also having a better public image by avoiding marine mammal entanglement. So engaging industry has never been a problem in this type of programme.*

Q – Comment: as an observer in Gulf of Alaska and Bering Sea we get placed on smaller boats and we do not know how the boats are going to be and how to sample as accurately and soundly as you can. In a recent trip my captain did not like my sampling technique, as he considers it to be not as random as other observers. After my first trip I wanted to cover my back so I contacted Alex Perry to make sure I was doing the right sampling, but also knowing I was going to be on the same vessel again. Having reassurance from advisors in the field and fast turnaround in getting answer is very helpful.
A – USA - Thank you for that comment. I enjoy discussing with captains that sometimes may not have the proper impression whether a sample is taken correctly, and I want to encourage you to tell the captains to contact me when they have any concerns.

Q – Comment: as an observer in the Alaska programme I had not heard of the project for sexing halibut until I got on to a small longlining boat. And I thought it was so cool, the fishers were fully engaged and just carried out doing it, and replied to my questions. My question is: you stated 79% accuracy come back from the 2016 data. Which sex was miss-identified more?
A – USA – It was not really a sex miss-identified. It was vessel specific or crew specific, some vessels were very accurate close to 100%, while one vessel had only 50% accuracy, so if that vessel reported all females they would have had a higher accuracy! We are now very interested in seeing what the 2017 data may show.

Q – I really like the programme of cutting and sex-tagging halibut. What sort of engagement with the industry do you have after the trip? Do you report back to the skippers on what you found from the trip?
A – International Pacific Halibut Commission - Yes, we do report back to the skippers. Typically it will be on our website or trough reports we provide or through our annual meeting process. As regards to specific fishers, they wait until the fisheries biologist that is sampling their catches has determined their percentages and they let them know. Fishers may be frustrated because not all trips they marked are sampled, because we still follow our random sampling protocols. However our field staff is great and we would work with them even on a trip that was not sampled and stay late to determine the ratio to have that positive feedback and encouragement for the programme.

Q – Are you collecting any other biological information other than lengths? As we moved to EM in Alaska, we definitely noted that some spatial and temporal coverage area was missing information that was previously covered by observers. If you were to move to a reference fleet, where fishers would collect biological information, do you have a coverage level do you would continue to observe to do the data quality control and compare to?

A – The Netherlands – On the first question, there is already a lot of biological information that is collected already in these vessels, but not necessarily per haul but normally would collect information by a production unit, a certain quantity of fish with certain properties that are the same. But depending on the species they may measure weight, fat content, stomach fill, gonad weight but only when it is relevant for the market. For those fisheries we have a lot of information, not by haul but by day or couple of days, and we are at the moment building a research programme to use that data for biological research. Second question regarding the reference fleet: my vision that im working is to have the whole fleet as the reference fleet, and not have a subsection of the fleet used as a reference. As they are already collecting data we are capitalising on what is already there and simply making it more efficient to collect. At the moment we use excel spreadsheet based tools that work very well, but we are at the same time building a software platform that will allow storage of that information for the companies and that we can also extract that information for research.

Q – You said previously that you did all this outreach and that salmon bycatch was rare, so im wondering if you calculated what the bycatch rate was before, when you extrapolated, versus after you did the outreach and it changed the randomness of your sampling. Did you see any differences?
A – USA – Alaska groundfish databank for the past few years has been counting all the salmon dockside but NOAA does not rely on that data. NOAA uses only observer's data and we could compare anecdotally pre and post numbers using groundfish databank has collected. But we either start trusting the numbers that are delivered or potentially use EM on board the vessels to determine 100% retention or that discarding is not occurring, but it's very difficult to come up with a meaningful comparison. There is no way of knowing whether or not salmon numbers became more accurate because before or after the implementation of the outreached programme we rely solely on observer's numbers and the comparison is not meaningful.

Q - The industry programmes you presented from Europe are very limited in number, as most observers programmes in Europe are state based run by research institutes, and there are very little observers programmes run and paid by the industry or massive programmes of self-sampling. Industry participation in monitoring is key and we do not seem to have a lot of that in Europe, or as much as we could have. So I was wondering if you have any insights to improve that, since you are running an industry programme and your industry is involve? How did these industry programmes started and how can we improve collaboration with industry in other Member States in Europe? Anything you can share based on your experience?
A – UK – I think the programmes started due to external pressure, in our case the cod recovery programme. The industry was called to prove they were doing well and that they could achieve some results. The programme continued as it was perceived to be a good thing to participate and have a say into what was provided, the perception of data ownership collected by an industry managed programme was also important.
A - The Netherlands – Ownership of information is really valued by the industry, and also the feedback mechanisms that we have implemented are very important, and they can be very simple, but they are very efficient in creating the communication about what they collect and what it means in the bigger picture. Industry has a huge amount of information and by making visualisation of their information possible it keeps their engagement in a very

efficient way, and this is a way of making more observer programmes more efficient by providing this feedback, before and after each trip.

Q – When you are plotting length frequency distributions and you had similar distributions, but you did had differences. Is there is a systematic measurement error between observers and industry or is it a technique? And is there scope for more industry engagement to improve methodology?
A – The Netherlands - There is definitely scope for more in-depth analysis. The plots were finalised on Friday afternoon, and it was the first time we had the information together and data by haul. And we definitely need to look more on this and hopefully will lead to a paper and not just on length frequencies, but also maybe on total number. But definitely we need to look more on statists and metrics.

Q – I'm interested in validating industry reported data through outside sources. But I was surprised that fishers were collecting data from the cuts but then that data was lost because it was not subsampled, and I wonder if fishers do trip reporting and if they also report on sex-ratio of halibut or if only shore side observers do that reporting.
A – International Pacific Halibut Commission – It's a fair point. We did collect the data primarily in our dock side sampling programme that we have for decades. We did some collections more on PR side and less for maintaining the data. We validated it through genetic subsampling as to make sure fishers are accurately recording the sex through their cuts.

Poster Presentations – Extended Abstracts

The Norwegian Reference Fleet - the stakeholder's perception of the collaboration

Tom Williams, Sofie Gundersen and Tom Clegg

Institute of Marine Research, Norway

The Norwegian Reference Fleet (RF) is a collaboration between fishermen and the Institute of Marine Research (IMR) that started in 2000, and currently consists of 14 high-seas vessels and 24 smaller coastal vessels. The RF utilize a wide range of gears and fish throughout the entire Norwegian fishing zone, sampling their own catches on a regular basis.
In the spring of 2018 a questionnaire survey was sent to both RF vessels and IMR scientists, to learn more about how the collaboration is perceived by both parties. We were interested to gain feedback on how the collaboration is performing regarding the RFs objectives, and to see whether there were any differences in the perceptions, opinions and expectations between the scientists, the coastal RF and the high-seas RF. From the results of the survey it was possible to find some apparent differences in the answers between the scientists and the RF, and between fishermen in the coastal and the high-seas RF.

The most motivational factors for the fishermen's participation in the RF were listed as "*Social responsibility and a wish to strengthen fisheries management*" as well as "*The opportunity to contribute to marine research"* by fishermen in both the coastal RF and high-seas RF. "*Payment"* was seen as a more important factor by the fishermen in the coastal RF, than in the high-seas RF, but both regarded it as the second or least important motivational factor.

Supplying scientists with data for stock assessments and quota advice and was regarded by all participants as the RF`s most important role. The questionnaire revealed that data from the RF is used directly or indirectly for research on 31 of the 88 fish stocks and other marine resources that IMR give advice on. Documenting total catch for all species (including bycatch and discards), was ranked second in importance by both fishermen and scientists. The RF is also the primary source of data for discards and bycatch, since Norway does not have a formal observer program for its fisheries. Most of the fishermen stated that sharing their knowledge with scientists is an integral part of the cooperation. They ranked this as more important than the RF just contributing to a good dialogue between fishermen and scientists. Moreover, the high-seas RF ranked this, sharing their knowledge, as the second most important role. The scientist's, however, were more inclined to rank contributing to a good dialogue more important than the fishermen sharing their knowledge.

Both fishermen and scientists were asked to give their opinions on the quantity and quality of the work carried out by the RF. The majority answered that the work was carried out "*to a high standard"*, meaning that they believed the RF delivered both in quantity and quality in accordance with the scientific procedures. Some scientists did however have concerns about the quality of the catch sampling. A small proportion of the fishermen also had the same concerns about the quality of their work, but more so on quantity - their ability to deliver and carry out all the tasks stipulated in the procedures. These concerns were more common for the coastal vessels, which have a limited crew onboard to share the extra workload that comes with being in the coastal RF.

When asked about the future of the RF, the fishermen and the scientists were unanimous in their opinion that the RF will continue to play an important role in the monitoring of Norwegian fisheries. However, approximately half of both the fishermen and scientists, believed the concept will change considerably in the next ten years. The changes were expected to primarily concern technology and the potential to automate scientific tasks such as measuring lengths of fishes and species identification.

PTNS 2.0: A case study on outreach when implementing a new technical update to an industry facing system

Margaret Heinichen, Katherine McArdle, Michael Palmer

NOAA Fisheries, USA

As monitoring programs become more technologically advanced there is an increasing need for communication and outreach with primary stakeholders. Industry adoption of new data collection programs and systems can be challenging as some industry members may be more comfortable with current systems. The outcome of a successful outreach initiative would be to reach as many stakeholders possible with them absorbing the maximum amount of information during the outreach event. Other measures of success would be approval by the industry, compliance of new protocols, and for the industry to feel like their inputs were valued.

At the beginning of the 2018 Northeast Groundfish fishing year (May 1, 2018), the Northeast Fisheries Science Center (NEFSC) rolled out an update to the Pre-Trip Notification System (PTNS). Fishermen are required to notify through the PTNS for all groundfish trips at least 48 hours in advance. The PTNS uses a randomized process to facilitate selection of multiple types of observer coverage, which would include a waiver, selection of an At-Sea Monitor (ASM) or selection of a Northeast Fisheries Observer Program (NEFOP) observer. The PTNS was originally designed to meet observer deployment needs for the groundfish fishery as they existed in 2010. Much of the sampling design was hard-coded into the system, so very few changes to the system could be made. There was a need for a more flexible system that could adequately handle the complicated and everchanging requirements induced by a complex and dynamic management regime. PTNS 2.0 was primarily driven by this need for flexibility rather than industry requests for improvements to the user interface or selection mechanisms. However, PTNS 2.0 had significant changes to the user interface that needed to be communicated to fishermen.

The NEFSC has been in regular communication with the fishing industry over the years about the operation of the PTNS. Many fishermen notify for their groundfish trips via phone and are eager to express their ideas for system improvements during the conversation. There was no formal input solicited by the industry regarding PTNS improvements, however, the NEFSC has been accumulating informal requests overtime to improve the usability and functionality of the system. Requests made by fishermen included bulk entry of day trips, a mobile friendly website, and a built-in mechanism to ensure greater equitability of coverage among vessels in a sector. Many of the requested changes were accommodated, but not all.

Industry outreach for this update was completed on a compressed timetable with only 5 months from the time the outreach planning began to the time the PTNS 2.0 was activated. The NEFSC utilized 'lessons learned' from other outreach initiatives to help frame the PTNS outreach plan. A total of eight port meetings, 1-3 per week, were held to show fishermen the new system. Events were advertised through email announcements and launch websites from the NEFSC's Communications Branch, social media updates, and weekly reminders to sector managers and industry members. Meetings generally had low attendance (2-6 fishermen) with a few port agents, staff from the Greater Atlantic Regional Fisheries Office (GARFO), and observer provider representatives attending. At least one individual at each meeting had thought that the meeting was to discuss updates to the vessel monitoring system (VMS) which is another mandatory pre-trip system used by many fisheries.

During the outreach event the outreach team started with a presentation describing the technical and potential policy changes and then went into a demonstration of the actual system using a test site. Outreach was also done through user manuals, formal discussions at established outreach events, and informal discussions with industry members via phone or email. The presentation was generally useful, though some attendees lost interest as there was a heavy focus on regulatory history as to why the PTNS was required. The fishermen in attendance found the demonstration helpful to be able to walk through certain situations. User manuals have the potential to be a good reference for users with only a few questions. Formal outreach events had much better success when the audience was exclusively groundfish fishermen rather than including those who participate in other non-groundfish fisheries. Informal discussions only occurred when an industry member reached out to the PTNS team, but it was extremely beneficial in being able to focus on specific topics that the stakeholder cared about.

The following are the top lessons learned from this outreach initiative.
● Allocate as much time as practicable to outreach preparation before system rollout.
● Plan outreach events in conjunction with already occurring fisheries sector meetings in order to reach the largest audience as possible.
● Be flexible. Always have a backup plan.
● Ensure consistent communication between the development team and outreach team so that the outreach team feels comfortable answering technical questions.
● Have an industry member who is comfortable using the system present at the outreach event.
● If possible, include a narrow topic on the agenda for a larger, multi-topic event.
● Be prepared to take time for industry members to voice general concerns. They may be more attentive to the focus topic if they are able to first discuss other subjects they want to bring to program's attention.
● Provide contact information for someone available to answer follow up questions after outreach is completed.
● Set aside time after outreach for the development team to make small changes as industry familiarizes themselves with the system and offers suggestions.
● Work with the policy team throughout development and outreach so that policy decisions related to the system use are aligned with the technical capabilities.
● Have a government policy representative there that can answer general policy questions if needed.

Despite the time invested in outreach, only 15%-20% of system users were reached in our meetings (~35 fishermen). Industry members were unavailable, uninterested, or not aware of the port meetings. If the outreach was to be repeated, there would be more effort to join outreach presentations with existing fisheries group board meetings. Even with low turnout, most fishermen have successfully made the transition to using PTNS 2.0. The similarity in information collected between the old and new systems and the in-line help features led to very few fishermen reaching out with problems. Without connecting with PTNS staff, stakeholders have an incomplete understanding of the back-end system changes, however it is more important that the fishermen are able to use the system for it basic purpose – to assign observers to groundfish trips. On that regard, the new system is working well.

4

Involving Industry in the Collection of Needed West Coast Groundfish Data

Jim Benante[1], John Lafargue[2]

[1.] Pacific States Marine Fisheries Commission, USA

2. NOAA Fisheries, USA

Groundfish species on the West Coast of the United States were declared a federal disaster in 2000. Commercial sport fishing opportunities in Southern California were being severely limited due to several important species being declared overfished and harvest limits being greatly reduced. In response fishers began to ask tough questions about the data being used to manage their fisheries. They were unhappy with the amount and quality of the data available being used to manage the fish stocks they relied on to make a living.

Observer programs had seen dramatic growth in the United States from 1995-2000 in response to the need to better manage commercial fisheries. The fishery dependent data observer programs collected was helping to fill in some of the data gaps, but Southern California did not have much commercial fishing activity so there were very few data collection opportunities. Fortunately, observers during this time had gained valuable experience sampling at sea and working side by side with fishers and many had transitioned to new positions within National Oceanic and Atmospheric Association (NOAA) and other organizations. This created a unique opportunity to establish new cooperative research projects with willing fishers and scientists with a knack for sampling at sea on commercial fishing vessels and working closely with fishers.

The stock assessment for Bocaccio in 2002 stated; "Results of area-specific models indicates that [bocaccio in] Southern California is relatively less depleted [than Central California] and may have greater capacity for rebuilding." - 2002 Bocaccio Stock assessment (A. McCall). In addition the 2003 Bocaccio Stock Assessment Review stated; "The lack of reliable fishery-independent indices of stock abundance is a severe limitation for the bocaccio assessment, but this is true for virtually every other West Coast rockfish assessment." – 2003 Bocaccio Stock Assessment Review. After backlash from local Commercial Sport Boat fishermen in Southern California about the lack of data available to properly manage the fishery and in particular data from local untrawlable habitats, they were invited to participate in the data collection and monitoring processes.

In 2003 after meetings and discussions with a variety of active commercial and sport fishers in the Southern California Bight region, a pilot study was developed with the help of the local fishers to survey shelf rockfish resources in untrawlable habitats in Southern California using commercial sportfishing vessels as the research platforms. 14 years later a substantial data set has been compiled on the relative abundance of a large number of shelf rockfish in untrawlable areas of the Southern California Bight. In addition a variety of biological samples and oceanographic data has been collected. Key to this endeavour was involving local sport boat captains and their crew in not only the data collection, but the design of the survey. A common complaint fisheries managers hear is "you are not on the water every day like me, you do not understand what is happening out here, I have been doing this for 30 years!" Or the more concerning distrust industry has of the fisheries management process. Cooperative research projects can address both these issues by directly involving them in the collection of needed data. With over 35 years' of local experience each the three captains of the hook and line survey have combined knowledge base of over 100 years on the local waters. Combined with the knowledge of scientists, several of whom previously worked as observers, on how to carry out a scientifically sound survey, the project has established a valuable data set that directly contributes to the management of the stocks utilized by local commercial sport fishing vessels.

The survey has supplied annual abundance indices and/or biological data or samples for a variety of species and made available for use in stock assessments for the following species:

Blue Rockfish (2017); Bocaccio (2009, 2011, 2013, 2015, 2017); Cowcod (2013); Greenspotted Rockfish (2011); Lingcod: (2017); Yelloweye Rockfish (2009); Vermilion Rockfish (2005).

Each year the survey samples up to 221 sites. The depth range sampled is 37 m – 229 m. Three deckhands conduct five coordinated drops at each site using rod and reel, with a five-hook gangion. Biologists record species, length, weight, sex, and collect age (via otolith), and genetic (via finclip) information for each rockfish caught. A variety of environmental, oceanographic, and sampling information is collected to help develop probabilistic models used to predict species presence/absence on survey hooks and generate abundance indices for a variety of species for use in stock assessments. A CTD is deployed at each site following sampling operations. A towed camera sled is deployed to collect habitat information when time allows. The towed camera sled video is used to classify the habitats associated with each of our sites.

The cooperative approach employed by this survey has been effective in efficiently generating fishery-independent abundance indices and biological data collection for multiple groundfish species in untrawlable habitats. Industry vessels provide effective and relatively inexpensive research platforms that are reliable. The local fishers can provide valuable insight into the gear selection, fish behavior, location of viable habitats, local weather conditions, moorages, etc. This survey was developed from the outset with extensive input and guidance from the sport and commercial sectors. The methods of this survey are readily scalable into other areas along the US west coast and elsewhere. The gear is inexpensive and commonly available and the gear and methods can be tailored to the behavior and particular habitats of different species/groups.

This project has fostered an improved relationship between NOAA and the region's sportfishing industry. Working directly with the fishermen has provided numerous opportunities for mutual education and improvements to the survey and has encouraged fishers to become more involved and invested in the science and management processes. While there are several cooperative projects involving the commercial fishing sector, this survey is one of the few ongoing collaborations between NOAA Fisheries and the sportfishing industry.

Three vessels are chartered each year and there are three scientists onboard each vessel. Most years more than 50% of the scientists on the Shelf Rockfish Hook and Line Survey were previously fisheries observers. The skills developed working as observers by these scientists have been a big part of the survey's success. The skill set previous observers have allows for efficient and economical collection of high quality data and samples. The vessels that participate in the survey are normally used for commercial sportfishing trips, the scientists spend two days in port prior to the survey converting these vessels into research platforms (mobilization) by adding a variety of sensors and electronics. Each vessel is outfitted with an anemometer, CTD, a motion compensating scale, desktop computer, routers, tablets, barcode readers, printers, and a whole host of equipment used to log data and collect biological data and samples from fish. In 2017 the survey went paperless and utilized a series of networked tablets to directly input data into a database. After mobilization the sportfishing vessels are truly transformed into scientific survey vessels utilizing state of the art technical equipment and operated by captains and crew with a vast amount of local knowledge and experience.

Changes in Industry Behaviour and Fisheries Management Observed in the Australian E-monitoring Program

Bryan Bates

Archipelago Asia Pacific, Australia.

The Australian Commonwealth Electronic Monitoring (EM) program has been in operation within the Eastern and Western Tuna and Billfish (ETBF and WTBF) and the Gillnet Hook and Trap (GHAT) fisheries since July 2015. E-monitoring is required on vessels operating within the fisheries above a set number of days, with 75 vessels across the participating fisheries now installed with E-monitoring systems. Since the implementation of the program there have been several benefits and improvements realised in the fisheries. For instance, there has been a marked change in operator reporting behaviour and EM data has provided fisheries managers with an incite of at sea behaviours such as bycatch handling and discarding.

Annual CPUE was calculated from ETBF logbook data for all threatened, endangered and protected (TEP) species caught during fishing operations between 2009/10 and 2016/17 (Figure 1). A comparison of TEP species interaction rates indicates there has been a significant increase in vessel reported interactions in the 2 years following the introduction of EM.

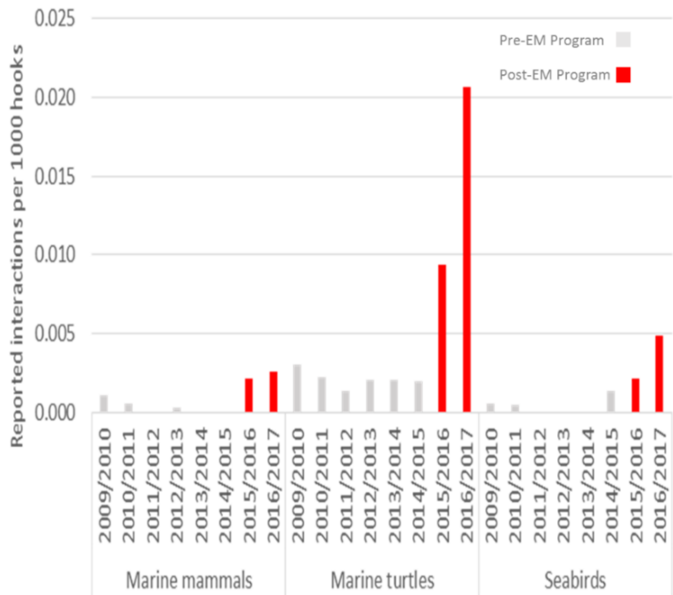


Figure 1: CPUE of reported TEP species interactions in the ETBF

The percentage difference in reported catches between logbooks and EM was calculated as the difference between the number of individuals recorded by EM and logbooks divided by the number of individuals recorded in the method reporting the greatest number. The mean percentage difference (i.e. congruence) between shots was then compared by fishery, vessel and species. A higher level of TEP interactions reported in logbooks then in EM derived data, this difference is reduced in the second year of the program. While the EM review has not captured some TEP interactions, the presence of EM has led operators to comply with reporting requirements.

EM has provided fisheries management with an additional tool for positive engagement with industry. Australian Fisheries Management Authority (AFMA) has recently released an updated industry guide of best practice handling of bycatch. AFMA has used EM footage featuring some of these examples in a new bycatch handling education video. Industry have widely accepted the new guidelines, part of the success of the introduction of new conditions has been education, to help ensure operators know what best practice looks like.

Improvements in bycatch reporting frequency in the CCAMLR Krill fishery through CCAMLR observer engagement with industry

Isaac Forster, Keith Reid

CCAMLR Secretariat

Introduction

Understanding the magnitude of fish bycatch in the Antarctic krill fishery has been the subject of extensive discussions at CCAMLR for many years, given the importance of non-target catch in the ecosystem-based approach to management implemented by CCAMLR.

All vessels are required to report all target and bycatch; independent scientific observers are tasked with sub-sampling krill catches and recording the number, weight and length frequency of each fish species. This information can then be used to quantify the amount of fish bycatch.

Despite the reporting requirements an analysis of vessel and observer reported catch data in 2014 showed a systematic difference in the frequency of occurrence of fish bycatch. As a result of this CCAMLR implemented a strategy to improve bycatch data quality reported from vessels and observers to better quantify bycatch rates

Methods

The CCAMLR Secretariat attended and assisted in industry and observer training workshops, and produced an identification guide to the commonly occurring fish species to improve the ability and consistency of observers to identify fish bycatch taxa (example plate in Figure 2).

The training sessions emphasised the role of observers working with vessels and industry to elevate the awareness of the requirement for bycatch reporting and improved identification of bycatch taxa, especially early life history stages.

Results

An analysis of the occurrence of fish bycatch between 2010 and 2017 from 100897 hauls from vessel data, of which 1627 were sampled by observers showed an increase in the relative frequency of fish bycatch in the vessel data relative to the observer data (Figure 1). During the same period there was also an increase the consistency of bycatch taxa reported in observer data.

Conclusion

A combined approach to awareness raising, training, improved reference material and collaboration between observers and industry has resulted in better quantification of the composition and overall amount of fish bycatch in the CCAMLR krill fishery. This improved data from observers and vessels on fish bycatch provides the potential to evaluate the potential impact of the krill fishery on the population of krill-eating fish species, including those fish that are the target species for other fisheries. Many of the taxa found as fish bycatch are not well studied and the improved data collection is providing research opportunities to better understand their life-history, particularly in the early life-history stages.

Figure 1.

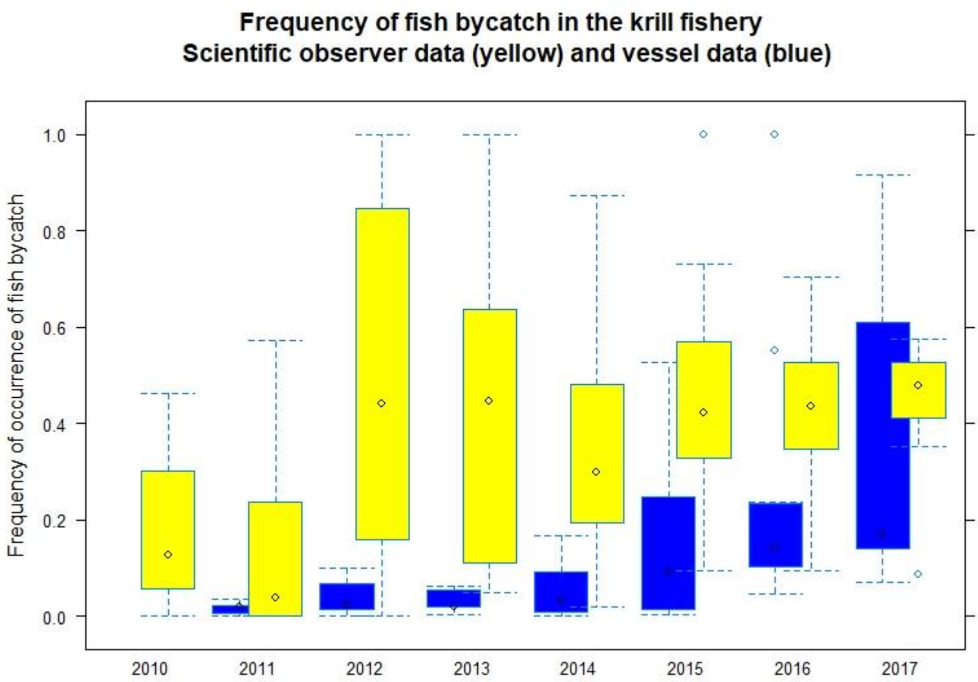
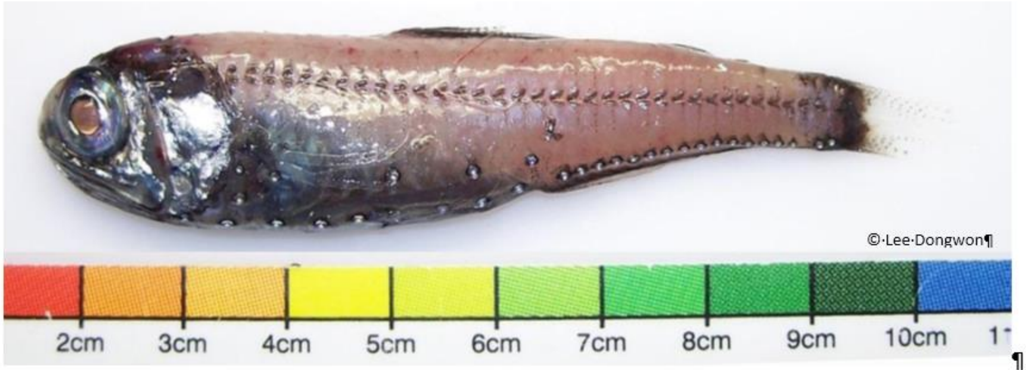


Figure 2. Example CCAMLR Bycatch Guide ID Plate

Figure 2. Example CCAMLR Bycatch Guide ID Plate

***Electrona carlsbergi* (Lanternfish) (ELC)**



Distinguishing features: No dorsal or anal spines. Dorsal soft rays 13-15; anal soft rays 18-20

Colour: Pale body with noticeable discrete silvery spots on posterior half of fish. Silvery colouring on breast and eye.

Size: To 9 cm TL.

Distribution: Widespread in the Antarctic

© Lee Dongwon

Depth: 100 to 350

Making fisheries monitoring economically beneficial for harvesters as a means to achieving sustainably managed fisheries

Julien Hawkins

Vericatch, Canada

Wider adoption of fisheries monitoring programs is dependent on demonstrating commercial benefits for the fisheries, therefore allowing for greater long-term engagement. Today, existing monitoring programmes are dependent on policy and legislation to drive uptake, but harvesters, despite their efforts to comply, are not seeing economic benefits. Market forces such as regulation is not enough to drive change, there is a need for a commercial and environmental payback, which will ultimately accelerate the move to sustainable, well-managed fisheries.

In general, while harvesters may accept the overall need to improve fishery management, safety, and sustainability, they object to having to pay for monitoring and reporting due to economic cost and mistrust of how data will be used against them.

Vericatch has developed solutions to meet these challenges called *FisheriesApp* and *KnowYour.Fish* to meet fishermen's needs, build trust and incentivize greater participation in well-managed sustainable fisheries. Vericatch, a Canadian based company, was founded by technologists and fishermen and has worked collaboratively with industry, NGOs and regulators to reduce the burdens of administration and increase benefits to harvesters through electronic reporting (ER) and a full service traceability programme.

To achieve this, the cost of the ER service was lowered, a faster implementation process rollout of platforms was initiated and the system links collected data for use in seafood traceability programs. By enabling seafood traceability, the ER system will have a direct and positive impact on the profitability of commercial fisheries and thus gives a clear reason why ER and fisheries monitoring is beneficial to those who use it.

Objectives

Vericatch works collaboratively with the Groundfish Trawl Fishery in British Columbia, Canada. A pilot was initiated with key producers and executive management to prove the commercial benefits and help promote the sustainability objectives of the fishery.

The objective of the project was to demonstrate the benefits of initiating ER and traceability to offset the cost and time of implementing monitoring by harvesters.

The hypothesis tested explored whether fisheries management using ER technology can increase market access to premium markets, reduces catch wastage, and makes pricing more predictable, thus demonstrating the commercial and environmental value of catch for progressive fisheries. By increasing access to market for this multi-species fishery and promoting the positive sustainability efforts of the fleet, the aim was to show the benefit as a means to improving livelihoods and demonstrating advantages to other fisheries.

Methodology

Vericatch, with over 10 years experience and renowned expertise in this area, developed a low-cost ER tool called FisheriesApp that enables harvesters to record catch data including key data elements (KDEs) within their designated fisheries.

FisheriesApp is an Android or web-based platform that can be quickly configured to each fishery's specific needs, creating an optimized data entry tool at a low cost. The application is available in local languages and can work without a permanent Internet connection to make it as accessible as possible. Once data is collected and compiled, fisheries can keep usable and up-to-date records of catch trending, which can form the basis of a fishery management plan for a FIP (fishery improvement project) for example. Data collected can be used for regulatory compliance and stock assessments, as well as proving the origin of seafood entering the supply chain.

In addition to FisheriesApp, Vericatch has been piloting KnowYour.Fish, the industry's first truly verifiable and traceable seafood supply chain platform, with the same fishery and associated brand-name processors in North America. Based on the positive results from the pilot, KnowYour.Fish has now launched to a broader customer base as a means of showing the commercial benefit to fisheries.

Results

Vericatch's customer data is highly confidential but it is possible to share that there was confirmed evidence of a **double-digit percentage increase in resale prices at wholesale for fish** brought in through the pilot.

While that percentage varies by commercial opportunity, it was considered significant by the fishery. And as costs remained largely the same for fish sold, the effective increase in profit was a significant > 30%.

Conclusions

Vericatch has been able to keep the costs of both platforms very low and design a tamper-proof, closed-loop monitoring and traceability process supported by major sustainability NGOs. This allows for FisheriesApp and KnowYour.Fish to be piloted with interested fisheries without a significant investment.

There are low barriers to entry for fisheries to pilot these products, the lack of upfront investment and short implementation timeline allows fisheries to quickly see the benefits of catch reporting and drives the value of moving to managed fisheries, often as part of a fishery improvement project (FIP).

Acoustic estimation of spatial distribution and abundance of hoki (*Macruronus magellanicus*) on the commercial fishing vessel Tai An

Madirolas Adrián, Hansen Jorge, Orlando Paula y Blanco Gabriel

National Institute of Fisheries Research and Development, Argentina

Introduction

- Modern acoustic equipment installed in many commercial fishing vessels enables the acquisition of information during fishing activities.
- The incorporation of digital echo sounders offered researchers the possibility of storing echorecordings acquired during the cruise.
- In this way, it is possible through specific post-processing programs, the further analysis of data in fisheries research institutes.
- The acquisition of acoustic information in "*ships of opportunity*" is being used worldwide allowing making observations of important commercial fish species, during periods of time where there are no scientific surveys.

Main objective

- Continuous acquisition of acoustic data during several fishing surveys focused to long tail hoki, one of the most important species present in the South West Atlantic Ocean.
- Evaluate acoustically the abundance of hake during the fishing trip between May-June of 2013

Materials and methods

- Fishing vessel "Tai An" is a 105 m long vessel equipped with automatic control fishing winchessystems. Tai An is one of the most advanced fishery vessel of the Argentine fleet.
- The vessel has echosounders SIMRAD ES-70 operating 18 and 38 kHz transducers andalso omnidirectional fishing sonar (SIMRAD SX-93). For "real time" monitoring the trawl operations, theship hastelemetry sensors.
- Echorecordings acquired were post-processing at INIDEP using Myriax-Echoview software.
- The values of the water column normalized by nautical mile or NASC (Normalized Area Scattering Coefficient) were averaged in distance intervals or "ESDU's" (Elemental Sampling Distance Unit) of 1 mn.
- Echograms were analyzed taking into account both, the information reported by the observer as well as the experience of the person in charge of processing the signals.
- Four functional groups were defined: Macruronus magellanicus, Micromesistius australis, mix1 (mixture of hake and grenadier) and mix2 (mixture between blue whiting and grenadier).
- To convert acoustic densities (NASC) into fish densities we apply the equation proposed by IFOP based on in situ TS measurement experiences of Macruronus magellanicus, carried out in the southern zone of Chile (Lillo et al., 2005a):

TS = 15.8 log10 (LT) - 66.0 dB

Results

According to densities series, resulting from the function proposed by IFOP to link target power and size of *Macruronus magellanicus*, the mean of the resampling suggested that the Hoki biomass in the area would have reached 31,632 tons.

TS Ecuation= f(modal or average size) :	
Reference	IFOP (Lillo et al, 2005)
Average Density Estimates	9,98
Average biomass estimates	31.632
Diversion of Biomass estimates	12.702
Confidence Intervals95%	
Lower Limit (Normal Distr)	6.736
Upper Limit (Normal Distr)	56.528
Per percentiles	
Lower Limit	15.579
Upper Limit	62.030

Table 1. Results of the Hoki abundance estimation by Bootstraping, considering TS equation proposed by IFOP.

Conclusions

- The use of opportunity ships allows obtaining information on the state of the fish resource, complementing the investigations carried out by scientific expeditions.
- The acoustic information collected by "Tai An" allowed us to estimate the biomass of the fish resources.
- There are limitations regarding of the representativeness of the estimation. However, the objective the monitoring is to obtain a relative measure of abundance of the principal fish species present in the area.

Bridging the Gap: A case study documenting the need for increased communication with the fishing industry in support of successful fisheries management.

Sara Weeks[1], Bradley P. Schondelmeier[2], Gerald O'Neill[3], Nichole Rossi[1], Glenn Chamberlain[1]

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[3]Cape Seafoods, Inc. Gloucester, MA

Bridging the Gap: The Northeast Fisheries Observer Program (NEFOP) and the Massachusetts Division of Marine Fisheries (MADMF) are working collaboratively with Atlantic herring fishermen to bridge the existing gap between fishermen and the regulatory process. The regulatory process is complicated and complex, and difficult at times to understand the practical application of the rules and requirements. We present a case study documenting the need for, and application of, increased communication between fishermen, monitoring programs and managers to support successful fisheries management.

In the Atlantic Herring fishery in the Northeast Region of the United States, the regulations have been modified extensively over the recent past. Several significant management actions have occurred. In 2013, Amendment 5 to the Atlantic Herring Fishery Management plan improved upon the collection of real-time data, enhanced monitoring of catch at sea and addressed bycatch issues relevant to the fishery. In 2014 framework 3 implemented a process for setting river herring and shad catch caps in the fishery, followed in 2015 by framework 4, which addressed discarding and slippage. Several amendments are also under development currently, Amendment 7 and 8, which further address industry funded monitoring and Atlantic herring and its relationship with the ecosystem.

Significant changes over time, in short duration such as have occurred with the Atlantic Herring fishery, can confuse and overwhelm those that are prosecuting the fishery in practice. Communication with the fleet can be in the form of fishery permit holder letters, outreach, Fishery Management Council updates, if representatives are able to engage. Both the NEFOP and MADMF work collaboratively with the industry on a variety of projects and are finding that the greater the level of communication, the greater the understanding of the information and adherence to the rules and requirements. Direct person to person communications are still the most effective means of information sharing. A meeting with the industry for one topic often allows for direct outreach of additional requirements as the industry wants information, but doesn't always have the time or are on land often enough, to find the information or to read the permit holder letter that they may have received. Supplemental fishery monitoring, such as the NEFOP/GARFO Electronic Monitoring pilot project, development of an At-Sea Monitoring program, or the MADMF portside sampling program, increases the amount of collaboration and the amount of data available for management, bycatch mitigation and research. These projects are just an example of the opportunities for increased outreach, which work to support the overall fishery, and successful management. The river herring bycatch avoidance program, which aggregates MADMF and NEFOP sampling data in near real-time, promotes industry accountability and ownership of results while addressing difficult management issues.

Overall these collaborations promote increased communications, allowing NEFOP and MADMF to further inform and ensure understanding of recently implemented fisheries management measures, such as discarding (slippage) prohibitions, conservation issues or upcoming industry-funded monitoring mandates. Such examples highlight the continued collaborations between the herring industry, the NEFOP and MADMF in support of successful management of the Atlantic Herring fishery in the Northeast Region of the United States.

Abstracts of presentations that did not provide Extended Abstracts

Green Sturgeon Research with the California Halibut Trawl Fishermen of the San Francisco Bay Area

Kevin Stockmann

NOAA Fisheries West Coast Groundfish Observer, San Francisco, USA

According to the International Union for Conservation of Nature, sturgeons are more critically endangered than any other group of species. Green sturgeon (Acipsenser medirostris) are anadromous fish occurring along the West Coast of North America. In 2006, the Southern Distinct Population Segment (DPS) of green sturgeon was listed as threatened under the Endangered Species Act. The most recent 5-Year Review: Summary and Evaluation affirmed the green sturgeon's status as threatened. A recovery plan is under development.

Green sturgeon are encountered as bycatch in the California halibut trawl fishery centered outside San Francisco Bay. Observers provide important contributions to the science and management of this species. Biological data collected by observers provide critical information for the analysis and continued monitoring of bycatch effects, supporting catch and mortality estimates by life stage, and clarifying the proportion of Southern DPS fish encountered versus the non-listed Northern DPS. Observer data also play an important role in addressing uncertainties regarding catch estimates and post-release impacts. Observers applied over 315 Passive Integrated Transponder (PIT) tags to determine a recapture rate. Observer data from the halibut trawl fishery represent valuable monitoring of the sub-adult population.

To assess post release impacts, NOAA Fisheries led a collaborative study with halibut fishermen, observers and the California Department of Fish and Wildlife. Observers and fishermen applied satellite tags to 76 randomly selected bycaught green sturgeon to estimate post release survival and to learn more about green sturgeon movement patterns. Tags were programmed to stay on the fish 3-4 weeks before popping off and transmitting depth, temperature and acceleration data. Of the 49 satellite tags that transmitted sufficient data, analysis suggested 81.5% of released sturgeon survived to three weeks, post release. This is the first study in the United States to quantify a

post trawl interaction survivorship rate for any sturgeon species. Scientists are using this data to evaluate the population-level effects of fishery bycatch on green sturgeon and formulate future recommendations for the fishery's long-term sustainability.

Engaging the halibut trawl industry on green sturgeon research and monitoring, especially the satellite tagging study, will facilitate future management decisions as NOAA Fisheries furthers its dual goals of managing fishery resources to realize their full economic potential, while conserving protected species and preventing overfishing.

Industry Involvement with Monitoring Sex in the Pacific halibut Commercial Fishery

Lara M. Erikson, Timothy Loher, Ian J. Stewart, and Claude L. Dykstra

International Pacific Halibut Commission

The International Pacific Halibut Commission (IPHC) has managed the fisheries for Pacific halibut (Hippoglossus stenolepis) from California to northern Alaska since 1923. To maintain product quality, commercial fishery regulations require that the gills and internal organs are removed at sea. Therefore, when the retained catch is offloaded and sampled dockside for age, size and weight, the gonads are no longer present and sex cannot be determined. In the absence of this information, uncertainty regarding the sex ratio of these removals represents one of the largest sensitivities within the current Pacific halibut stock assessment, particularly for estimation of female spawning biomass (currently informed by sex- specific age composition data collected from the IPHC summer fishery-independent setline survey). Pacific halibut demonstrate a variety of behavioural and seasonal characteristics such that commercial harvesters could encounter a very different sex-ratio than that observed in the summer survey. In order to estimate sex ratios within the commercial catch, the IPHC embarked upon a project within its existing port sampling program designed to generate and validate observational data from the fishery. This project comprised a combination of:

1) commercial harvesters voluntarily marking each Pacific halibut as either male or female as they dressed individual fish, and 2) biologists in port recording the marks and collecting tissue samples (fin clips) for future genetic analysis. In 2014, a marking method was developed consisting of two cuts in the dorsal fin for females and a single cut through the blind side operculum for males. The following year, a small pilot test was conducted with the cooperation of vessels landing retained catch in Homer, Alaska, USA. In 2016, voluntary at-sea marking was conducted by the commercial fleet throughout British Columbia, Canada. In 2017, the project was extended to all sampled ports (California through Alaska). The goal is to have routine data collection procedures in place for the 2019 fishing season, which may include a combination of at-sea sex marking by the commercial fleet and genetic validation. Fleet involvement has been excellent, with harvesters and processors reporting that marking was not disruptive of normal fishing activity, nor did it have any adverse effects on the marketability of the fish. The development of this project represents a successful collaboration between scientists and fishermen to improve the science available for management of a valuable fishery in the Northeastern Pacific Ocean.

Working Together to Work Together Better: A Review of Black Sea Bass and Summer Flounder landings in northeast Atlantic observer data over the last 20 years and a proposed method of working together better.

Sarah Fortuna

NEFOP Observer

One of the most difficult things about being an observer is getting on the boats. There are many reasons fishermen don’t want to take observers; the most prevalent is an aversion to the “big brother” effect. These people, many of them whom have grown up in coastal communities in families that have always had ties to the ocean, are not particularly fond of “big brother” being invited into the picture. Suffice it to say the federal government has always been involved in the harvesting of natural resources (ie. the ocean and its fishes) but before the observer program putting observers on boats it was in a less direct manner. Yes, the government controlled the quotas and landings but what went on out on the ocean was largely private. Many of the fishermen I have spoken with have few problems with observers it is largely the fact that the data that are collected “always has a way of being turned into a negative”. “They never get anything out of it.” Limits are lowered, areas are closed and once again the fishermen are left feeling used.

What if we give them something back? Within the scallop fishery the observers are paid for by the vessel, to balance the price of an observer the boats are gives extra quota. In some cases this can result in completely paying for the observer with money to spare. I am proposing a similar system within the bottom otter trawl fishery in the northeast. The species I propose using, based on fishermen interest, are summer flounder and black sea bass. These are two species that are highly sought after in the United States market but are also highly regulated. I propose doubling the allowed quota where plausible (ie. in states that have limits of 50-100lbs per trip). The overall quota for species would remain the same in contingency with the scientific research but individual landing per vessel would change. For example if you take an observer you could keep 100lbs of Black Sea Bass or Summer Flounder as opposed to 50lbs. I believe this would have a positive effect on observer fishermen relations. This report will also illustrate Black Sea Bass and Summer Flounder landings on NEFOP covered trips over the last 20 years and roughly what kind of change this type of system would have had if implemented in past years.

A collaboration with Norwegian fishers for documenting incidental seabird bycatch in the Norwegian coastal gillnet-fishery

Tom Williams

Institute of Marine Research/Directorate of Fisheries - Norway

The general decline of seabird populations worldwide raises large concerns. Although multiple factors are interacting to cause the observed trends, increased mortality from incidental bycatch in fisheries has proven to be important for many species. Yet, the bulk of published knowledge is derived from long-line fisheries, whereas bycatch in gillnet fisheries is less studied and even overlooked in some areas. There is no official observer program for monitoring incidental bycatch and potential discards of fish and other species in the Norwegian fisheries. This study was however able to utilize data from the Norwegian Reference Fleet, a group of Norwegian fishing vessels that are contracted by the Institute of Marine Research (IMR) to provide detailed information about their fishing activity and catches, including bycatch of marine mammals and seabirds. We present seabird bycatch data from a 10-year long time series of fishery data from the large fleet of small-vessels fishing with gillnets along the Norwegian coast - a large area and fishery with no prior estimates of seabird bycatch. In general, we document high rates of incidental bycatch (~ 0.0023 seabirds/net, or ~ 0.08 seabirds/fishing trip), although not exceeding estimates reported from long-line fisheries targeting the same fish species. We found that a comparatively higher diversity of both surface-feeding and diving seabirds were killed in the gillnet fishery, suggesting this fishery is a more general threat to a wider range of populations. Nevertheless, Common guillemot and Northern fulmar accounted for a large percentage of the seabird bycatch. The bycatch estimates varied between areas, time, feeding type, fishing depth and distance from coastline, and we were able to identify important spatio-temporal trends in the seabird bycatch, allowing for effective mitigation measures such as ambulant protection zones and fishing periods.

Galulue Fa'atasi- An Ongoing Success Story of Observer Program and Industry Cooperation in the American Samoa Fisheries.

Michael Marsik

US- NOAA Fisheries

In 2006 NOAA Fisheries established the American Samoa Observer Program to monitor effort, catch composition and record interactions with sea turtles, cetaceans and seabirds in the local longline albacore fishery. Over the course of the last 12 years the Fishery & Program have encountered many changes and challenges, but work very closely together to meet the monitoring needs necessary to ensure the long-term health of the fishery. Recently the Program expanded to include the large-scale US purse seine fishery. This short case study describes the relationship fostered between the Industry and Program.

Session 3. Monitoring artisanal fisheries

Leader Luis Cocas

Small scale artisanal fisheries occur throughout the world, ranging from one-man canoes in developing countries to greater than 20-m vessels in developed countries. They typically include a large number of boats and a diversity of fishing systems and gears, operating over wide geographical areas, making it difficult to monitor them for scientific and enforcement purposes. This session focused on exploring these challenges, providing an opportunity to discuss successful experiences and different approaches used. We examined methodological aspects, innovative solutions, the use of alternative sources of information, along with human, social and economic aspects that need to be considered when working in these fisheries.

Oral Presentations - Extended Abstracts

Small Scale, size isn´t everything: Issues and progress in monitoring European small-scale fleets.

Demanèche S., Mugerza E., Armstrong M., Adamowicz M., Carlshamre S., Clarke E.D., Couperus B., Dammers M., Dingsør G., Egekvist J., Elson J., Fernandes A.C., Gitarakos G., Grygiel W., Kiparissis S., Kovsars M., Krumme U., Nimmegeers S., Norkus D., Otterå H., Reis D., Rodriguez J., Saks L., Schembri S., Spegys M., Stoetera S., Vandemaele S., Vasconcelos R., Vølstad J.H., Thasitis I., Williamson K., Gerritsen H., Prista N., Ribeiro-Santos A.

CEFAS, UK

Data from commercial fisheries are essential input to stock assessments and often the primary basis for reconstructing historical populations and estimating fishing mortality. It is the aim of the ICES Working Group on Commercial Catches (WGCATCH) to secure better quality data to improve stock assessment. One of the main responsibilities of WGCATCH is to ensure the quality of commercial catch data by: 1) documenting national fishery sampling schemes, 2) establishing the best practices and guidelines for sampling, acquisition and estimation of commercial fisheries data, 3) promoting training courses and workshops on sampling and estimation procedures and 4) advising on the uses of commercial fishery data.

Since 2015 one of the terms of reference for WGCATCH has been to ensure that the collection of transversal, socio-economic, and biological data from small-scale fleets (SSF) across Europe are sufficient, harmonised and comparable. The following topics have been addressed:

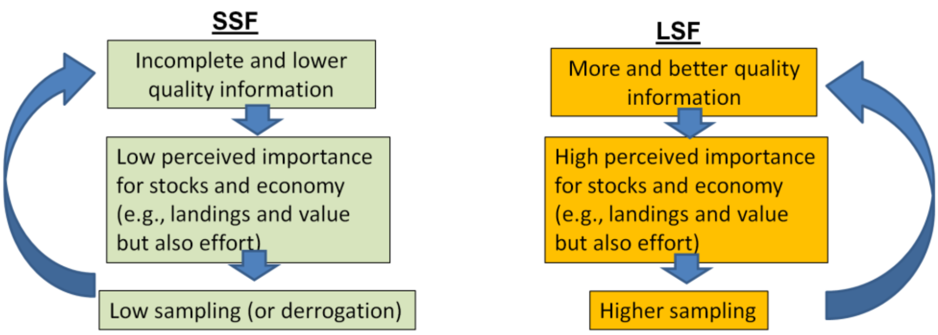
- ✓ National description of SSF, contribution to the total catches and fishing effort
- ✓ Overview of the current SSF data collection methods, pros and cons
- ✓ Best practice guidelines for fishing activity and biological data collection in SSF

- ✓ Evaluation of the usefulness of innovative/new technologies in monitoring SSF
- ✓ Discuss quality indicators and quality checking methodologies in SSF data

There is no single harmonised definition of SSF in the literature. The definitions used are determined by the end-user needs, and what is covered by the term varies largely between end-users. WGCATCH supports that for data collection purposes, it is practical and more precise to refer to fleet categories defined by the vessel length overall (LOA) ranges (<10m, 10-12m also 12-15m). WGCATCH adopted this pragmatic definition that is in line with the view adopted by previous expert meetings in the ICES and highlights that this definition is also related to the source of information available by fleet categories. For example (1) for vessels under-10 meters there is no legal basis under the Control Regulation for direct reporting of activity using EU logbooks, and (2) the LOA class 10-12 meters' vessels are not under Vessel Monitoring System (VMS) obligation (the LOA class 12-15 meters present also some exemptions in VMS data requirement).

SSF are important components of many fisheries in ICES areas and they have been receiving growing attention (e.g. within Marine Spatial Planning (MSP) initiatives). Around 70,000 SSF vessels operate in EU which amounts to 85% of the total EU fishing fleet. Although they are in general less active in term of days at sea than Large Scale Fleets (LSF), their importance is significant in term of fishing Effort in nearly all countries. At the same time, in the latest draft of the Common Fishery Policy (CFP), the European Commission has stressed the intention to promote the SSF sector and to provide them support. Within Europe, the multitude of SSF vessels and the local issues contrast with complex multi-level governance by regulatory and monitoring bodies that cover national and shared fish stocks and which often overlook the potential impact of SSF. In addition, the ecological and socio-economic impacts (e.g. in term of employment) of SSF are often little understood and largely underestimated, mainly due to the limited data available.

Preliminary results and several recent studies highlight the need to improve SSF knowledge to ensure their sustainable development. However, knowledge on SSF appears to be "trapped in a vicious cycle" where, due to incompleteness and/or lower quality of existing data, systematically lower importance is assigned to their characterization (down-weighting them in stock assessment and management advice) and sampling when compared to LSF.



National description of SSF, and their contribution to the total catches and fishing effort

Based on questionnaires, presentations, working documents and discussions within WGCATCH, building on previous works, the group documented the importance of SSF and how much SSF contribute to the landings and effort. Briefly, 1) SSF are an important component in nearly all countries (no particular north/south distinction) and their share of TAC-quota or regulated catches of species (including incidental by-catches of protected species) can be high, 2) SSF are highly important for fishery spatial management and socio-economic studies, 3) SSF present certain unique features: highly diverse, multi-gear, multi-species, geographically widespread fleets, involving full time, seasonal or part-time activities in coastal areas, which add challenges for the SSF data collection, 4) SSF vary regionally in terms of species, gears, metiers or fisheries, and 5) SSF data collection need to be improved.

<u>Overview of the current SSF data collection methods, pros and cons WGCATCH documented the sampling practices for SSF in ICES areas mainly.</u>
For SSF data collection on fishing activity, two main approaches are applied: Census and/or Sampling approach. A census approach mainly based on sales notes generates some particular issues, that have to be taken into account as sales notes could be used but are insufficient. Adapted declarative forms have to be used and accuracy/reliability/completeness of such data has to be assessed. The challenges related to the use of a sampling approach are mainly related to the statistical soundness of the sampling design, the logistical and financial constraints that reduce the sampling coverage, and the difficulties of assessing the accuracy/reliability of the data in case of self-reporting.

SSF biological data collection (on-shore and on-board sampling) is mainly included in a general (across all vessel sizes) sampling scheme. But there are some specific restrictions in sampling coverage for SSF especially linked to safety and space availability for observers during on-board sampling. It is therefore challenging to obtain reliable estimates of the overall SSF discard rate or incidental by-catches of PETS (Protected, Endangered and Threatened Species) even though SSF can have a significant contribution.

Across Europe: 1) there is a wide diversity of methodologies used for monitoring SSF which introduce/create challenges in harmonising and standardising the SSF data and the quality indicators across countries, 2) there is a need to develop a best practices guideline for design, implementation and quality assurance of SSF data collection methods in order to reduce bias, increase precision and improve cost efficiency, 3) SSF data collection could benefit from innovative/new technologies to improve data quality and 4) there is a need to develop quality indicators and data quality check methodologies.

<u>Best practice guidelines for fishing activity and biological data collection in SSF</u>
WGCATCH drafted generic and specific guidelines on the best practices for collection of transversal and biological data in SSF which deal with: 1) quality issues (e.g. design, implementation error, refusals, accuracy, estimation method, etc.), 2) assessment of accuracy/reliability/completeness of the available data, 3) appropriate sampling schemes and adapted declarative forms to monitor SSF, 4) census vs. sampling approach (issues of cost efficiency and precision), 5) key issues to sample SSF biological, discards and PETS data on-shore and on-board, and 6) spatial mapping of SSF activity.

The first stage is to define the main end-users needs (i.e. identify the target population and the type of estimates, their resolution and the level of precision required) which allows to define the objectives/data needs (types, resolution, precision and quality of estimates, domain of interest). The resolution may refer to spatio-temporal strata, gear types, etc.

Another important initial step is the pre-screening or frame survey of the fishery which provides useful information to evaluate the best data collection method (based on factors such as accessibility of the vessels, fishing and landing patterns, part-time activity, gears, target species, etc.) that will constitute the general framework of the data collection. Other stages are mainly related to: sampling scheme design and implementation, data capture and quality control, data analysis and accuracy indicators and feedbacks to improve data collection.

<u>Evaluation of the usefulness of the innovative/new technologies in monitoring SSF</u>
WGCATCH discussed how new technologies such as remote electronic monitoring (e.g. CCTV), new apps for smartphone/tablets, geolocalization devices (AIS/GPS), RFID Tags, and other methods, could improve SSF monitoring. There are significant opportunities to improve SSF data collection using innovative technologies, for example to access detailed information on effort with high spatial resolution data or for self-sampling of PETS or discards data. To improving knowledge-sharing, the first output of WGCATCH was a review of different technological projects ongoing in the ICES area.

<u>Discuss the quality indicators and quality checking methodologies in SSF data</u>
WGCATCH will engage a discussion on quality indicators and quality checking methodologies using case studies. WGCATCH 2017 has elaborated a questionnaire on these specific features that will provide the data needed for further work WGCATCH 2018, especially focusing on the coverage/completeness and the accuracy/reliability of data collected in a census approach and the way to assess the proper use of statistical soundness in a sampling approach.
WGCATCH developed work on standardisation and harmonisation of SSF data. In 2017, the first discussions were engaged on fishing effort calculation and a questionnaire has been elaborated for 2018, which will help to finalise the work.

Finally, WGCATCH advice and expertise is needed to achieve following objectives: 1) monitoring the implementation of best practices guideline and advise on regionalization of data collection, 2) standardizing reporting and RDB (Regional Data Base) formats to include SSF data estimates. These objectives define the future WGCATCH work on SSF monitoring.

Further complete information can be found in the WGCATCH reports of 2015-2017, available on the ICES website:
http://www.ices.dk/community/groups/Pages/WGCATCH.aspx.

Monitoring Small-Scale Fisheries in the Azores: tools to support decision-making

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The Common Fisheries Policy, which represents the European fisheries policy and its relationship with the marine environment, requires member states to implement efficient management measures to ensure the social, economic and environmental sustainability of extractive activities. Maintaining sustainable fisheries is increasingly a key factor for the protection of marine and social resources and is crucial on the promotion of a long-term policy for fishing.

Efficient management can only be achieved if based on information obtained through fisheries monitoring that will assist in developing and accessing appropriate measures. That also contributes to the fishermen awareness on the consequences of excessive fishing effort on certain species, motivating the acceptance and understanding of management rules, as well as the adoption of conduct codes, such as those proposed by the FAO or by the European Commission.

Those facts were soon recognized by decision makers, researchers and fishermen in the Azores (Portugal) where fisheries are mainly composed by a small-scale artisanal fleet.

The uniqueness of the Azorean waters, characterized by the absence of a continental shelf and surrounding great depths, besides limiting the available areas for fishing activity, requires a very careful application of the precautionary principle in order to guarantee the biological conservation of the fishery resources. In fact, the Economic Exclusive Area of the Azores has a lot of water, great depth and little fish. Fisheries in the Azores, despite being artisanal target mainly deep-sea species that are characterized by slow growth rates, late sexual maturity, few offspring and long lifespans. This makes them highly vulnerable to overfishing, because their capacity to recover from depletion is very limited. This concern is clearly evident in the recent positions of Parliament, the Council and the European Commission on fishing for deep-sea species in the North-East Atlantic. Accordingly, a careful management must be done in order to keep their exploitation sustainable and avoid the rupture of its delicate biological balance. This is the reason why any processes of over-fishing can very quickly lead to exhaustion and implies a complex and prolonged recovery.

Assuming the challenges of manage a diversity of fishing gears and considering the biological characteristics of the target species and the concerns they rise on conservation status, the Azores Region developed monitoring tools to approach sustainability standards since the 80´s. The Azores fisheries observer Program (POPA), created in 1998, is part of that strategy, ensuring detailed collection of scientific data through embarked fisheries observers with special emphasis on pole and line tuna fishery. Concurrently an annual survey program (ARQDAÇO) was created in the 90’s to assess abundance, biology, distribution and migration of demersal species. An annual spring survey is schedule on board the Azores research vessel “Arquipelago” where the deployment of a commercial bottom long line gear is carried out by mixed crews (scientific and former fishermen) from March to August.

In 2000, an EU framework for the collection and management of fisheries data was implemented under the Common Fisheries Policy. Under this framework the region collect and manage biological, socio-economic and environmental data of local fisheries. Information on catches was achieved through a specific observer program that deployed observers on long line and hand line vessels in all Azores area. The Regional government is also partner and co-founder of several scientific projects that are focused on data collection and surveys. Concerning the highly pelagic migratory species the scientific project Consolidating Sea Turtles Conservation in the Azores (COSTA) managed by IMAR (Institute of marine research) has ensured the collection of catch data and effort from the surface longline fishery since 2015 including the delicate subject of marine turtles by-catch. A monitoring, control and surveillance (MCS) system is implemented in the Region that is currently expanding the already established, since 2010 the Vessel Monitoring Systems (VMS) to all fleet segments to track and monitor all professional fishing activities in Azores area. Additionally, during the last couple of years, the Region has also installed surveillance cameras in some harbors to control and dissuade illegal practices.

Despite the inherent difficulties of assemble a truly effective strategy in an Archipelago with such specificities we can reaffirm that proper management of fishing resources is a high priority for the Azores regional government. In fact, we are strongly committed in maintaining and developing monitoring programs since we consider that those are the most effective tools to achieve our sustainability targets in the medium-term.

A new approach to estimate landings and fishing effort of small-scale fisheries by re-evaluating declarative data from the IFREMER exhaustive activity calendar survey. Application to the French Mediterranean vessels.

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The 1289 *(year 2017, 1087 active vessels)* French Mediterranean continental *(without Corsica)* vessels are characterized by a predominant part of small-scale coastal vessels *(91% of the vessels are less than 12 meters and 83% less than 10 meters)*. This is a polyvalent fleet *(often practicing more than one métier during the year and sometimes during the same fishing trip)* practicing a large diversity of métier *(mainly passive gears)* from diving to dredges, also nets, pots, beach seines or fyke nets. Fishing activity is mainly practiced in coastal area *(included pond fishing)* and concentrated in the *3-12* miles boundaries. Consequently there is a large diversity of species landed. All of that introduce challenges for their fishing activity data collection.

Since 2000, Ifremer has implemented a Fisheries Information System *(FIS)*, a permanent, operational and multidisciplinary national monitoring network for the observation of marine resources and their uses, allowing an integrated and comprehensive view of fishery systems including biological, technical, environmental and economical components *(Leblond et al. 2008)*. The FIS covers all the French fisheries, including small-scale and overseas fisheries.

One of the originalities of the FIS lies in the fleet monitoring procedure: a comprehensive collection of annual fishing activity calendars of the national fishing fleet register' vessels aiming at characterizing the inactivity or activity of the vessels each month of the year and, in the latter case, the métiers practiced *(use of a gear to target one or several species)* and the main fishing areas *(Berthou et al., 2008)*. This survey covers all the French fishing fleets *(exhaustive characterization of the national fishing fleet register)* and provides minimum but exhaustive information on the vessels, giving structural information of the fisheries surveyed. The objective is to have a complete picture of the whole fleet in terms of monthly fishing activity schedules indicating notably the main fishing grounds and métiers operated by the vessels.

Annual fishing activity calendars survey provide input each year for, by example, the typological classifications of vessels by fleet, the complete description of their fishing activity or the definition of efficient sampling plans to structure the routine data collection. They are also used to assess the completeness, reliability, accuracy and pertinence of the declarative data (*sales note, logbooks and monthly declarative forms)* available.

For example, in 2012, incompleteness' indicators based on a comparison of all the declarative data available *(compiled through a cross-validation tool of all the different declarative sources ; tool aiming to provide the best possible fishing statistics data and to build a dataset compiling the most accurate and complete information for each individual fishing trip)* with the exhaustive fishing Activity calendars showed that the less than 12 meters French Mediterranean continental fleet was affected by a crucial lack of data, regardless the region considered (*less than 20% of the fishing month in 'Provence Alpes Côte d'Azur' region (PACA) and 40% of the days at sea in 'Languedoc Roussillon' region (LR))*. On the other hand, declarative data of Large Scale Fleets *(>=12 meters)* are much more complete *(75% of the vessels for PACA and 95% of days at sea for LR).*

Such missing data generate difficulties to estimate fishing activity variables of these vessels *(landings and spatial fishing effort estimates)*. In fact these data have been assessed as incomplete and imprecise and therefore as insufficient to meet the end-users data needs *(e.g. DCF requirements)*. Consequently, and since 2008, a complementary sampling approach has been deployed in the Mediterranean area (*GSA7)* for vessels under 12 meters to monitor this fleet and estimate their fishing activity variables *(Demanèche et al., 2013)*. The sampling scheme consists in a cluster weighted sampling of fishing trips *(catch assessment survey, spatio-temporal on-site sampling plan)* based both on the fishing fleet register (*administrative data)* and the Ifremer annual activity calendar survey.

However, recent analyses showed that the quality/representativeness and the completeness of the available declarative data is increasing since 2012 ; indeed incompleteness' indicators improve and are undoubtedly in an increasing tendency both in LR and PACA regions. For example, in 2012, 78% of the active LR less than 12 meters vessels had at least one declarative data available when this percentage achieve almost 100% of them in 2016. Analysis showed also that data quality/representativeness and completeness improvement affect all the length classes *(from less than 6 meters vessels to 10-12 meters vessels)*, all the fishing areas and all the métiers. It could be then concluded that today the declarative data available integrate all the different parts/types of fishing activity taking place in the French Mediterranean continental less than 12 meters fleet.

Nevertheless, and that for the two regions, available declarative data remain still incomplete as it is *(for example only 69% of the vessels in LR and 30% of the days at sea in PACA with declarative date available in 2016)*. Therefore their data have to be re-evaluated/re-assessed/elevated in order to represent the reality of the total fishing activity of the fleet.

Consequently and following this increasing, trend an alternative methodology *(different from the Catch Assessment Survey)* has been developed in order to estimate the fishing activity variables of the vessels, based on a re-evaluation of the available declarative data scaled to the annual fishing activity calendar survey.

An empiric coefficient of re-evaluation is defined by métier based on a comparison of the comprehensive fishing activity calendars and the available declarative data:

$$\begin{cases} \tau_m = \dfrac{\textit{number of months in Activity calendars}}{\textit{number of months in declarative data}} \\ \tau_d = \dfrac{\textit{number of days at sea in Activity calendars}}{\textit{number of days at sea in declarative data}} \end{cases} \rightarrow \tau = \frac{\tau_m + \dfrac{{\tau_d}^2}{\tau_m}}{1 + \dfrac{\tau_d}{\tau_m}}$$

The coefficient has been defined after an optimization analysis and is based on two basic coefficients, the first one τm comparing the number of month for the métier observed in the annual fishing activity calendars and the number of month for the métier available in the declarative data, the second one τd comparing the number of days at sea in the two data sources.

For a given métier, based on this coefficient and fishing activity variables *(fishing effort-number of fishing trips, landings by species)* directly available in the declarative data, total fishing effort *(number of fishing trips, fishing days and days at sea are assimilated)* and total landings by species are estimated.

The method is then embedded in a probabilistic framework in order to estimate confidence intervals of the re-evaluated indicators. A probability that a fishing trip is available in the declarative data is modeled following a probabilistic bernouilli experiment law scaled to the coefficient of re-evaluation observed for the métier. Imprecision around this probabilistic law is then fixed arbitrarily at 10% to construct confidence intervals for the re-evaluated indicators.

$\mathbb{P}(n = k) = \binom{N}{k} \dfrac{B\left(k + \frac{\beta}{\tau - 1}, N - k + \beta\right)}{B\left(\frac{\beta}{\tau - 1}, \beta\right)}, k \in [\![0, N]\!]$	$IC_{95\%}(Q) = \left[\hat{Q} - 1.96\sqrt{\mathbb{V}(\hat{Q})};\ \hat{Q} + 1.96\sqrt{\mathbb{V}(\hat{Q})}\right]$

The methodology, including the calculation of the precision and finally enable the calculation of all the fishing activity variables by métier and also by fishing area for French Mediterranean continental less than 12m fleet. Comparison with fishing activity variables estimates calculated through the Catch Assessment Survey *(today on-going)* has been done and it concluded that results are similar *(similar patterns and values)*. It has been demonstrated for the region LR but also for the region PACA although their declarative data are much more incomplete. Good quality results could be provided by the method until the declarative data is sufficient to represent the diversity of gears and fishing area practiced by the fleet considered and until fishing activity calendars are well designed, complete and of good quality.
Finally, an alternative method based on the declarative data has been has been developed, it is a promising method which proved to be applicable in a wide context in case of increase of declarative data.
In order to apply it, the following points have to be taken into account:
⇒ Quality and representativeness of the available declarative data should be assessed before

⇒ Quality of the estimates calculated is depending of having a well designed, complete and good quality comprehensive/exhaustive *(covering all the vessels)* fishing activity calendars.

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What Happens at Sea: Results and challenges from Electronic Monitoring and Vessel Tracking in Small Scale Tuna Fisheries in Molluca and Celebes

Wahyu Teguh Prawira

Yayasan Masyarakat dan Perikanan Indonesia

Artisanal fishery in Indonesia are consists of some fishing gears e.g. gillnet, purse seine, hand line, and other traditional fishing gears. Tuna hand line is dominantly used in the coastal waters of Buru Island, Seram Island, and Sulawesi which has proven to highly caught yellow fin tuna. In Maluku and Central Sulawesi, there were at least 51,575 of 5GT hand line vessels with the highest fishing production 54,988.20 tons in 2016 (Marine and Fisheries Government service of Sulawesi Tengah Province 2015-2016; Marine and Fisheries Government service of Maluku Province 2015).

This research aimed to verify the fishing ground coordinate and ETP interaction on under 5 GT hand line vessel, whether the information collected in our port sampling system is accurate. Therefore this project is also to see whether such devices can be used to provide the information required by national and international import and traceability requirements; **Affordable, Acceptable, but also scalable and easy to integrate across other platforms and devices**. In this study, we did some approaching strategies principally needed to engage fishing association to implementing traceability based technology (TBT).

The Vessel Characteristic

The hand line vessels in this project is made from (combine) wood and fiber using portable 5 – 15 HP engine. They are usually plugged off the engine after fishing and plugged in before fishing. All of fishermen in these four regions are going fishing in the morning and back home in the evening.

Place (s)	Length (m)	Width (m)	Depth (m)
North Buru	8.7	1.4	0.7
South Seram	9	1.5	0.8
North Seram	6	0.6	0.5
Tolitoli	13.5	1.4	0.9
AVERAGE	**9.3**	**1.26**	**0,73**

Figure 1. The Vessel Size

The vessel length is around 6 – 13 meters, which is actually not impossible to deploy a human observer, but will be very difficult to deploy an observer onboard since there are maximum 2 persons on board consist of the captain and its crew. There also huge space needed on board for the fish/cool box. As mandated on Seafood Import Monitoring Program, we are initiatively put small devices called **Spot Trace (ST)** and **Time Lapse Camera (TLC)** to provide the data needed.

Time Lapse Camera and Spot Trace Deployment

Since August-December 2017, there were 14 units of Time Lapse Camera and 25 Spot Trace deployed in North Buru, Tolitoli, South Seram, and North Seram. There were at least 152 fishing trips using time lapse camera and tracker device from 37 hand line vessels or 14.45% from a total of 246 registered hand line vessels on the I-Fish database, and involving 75 fishermen during the process.

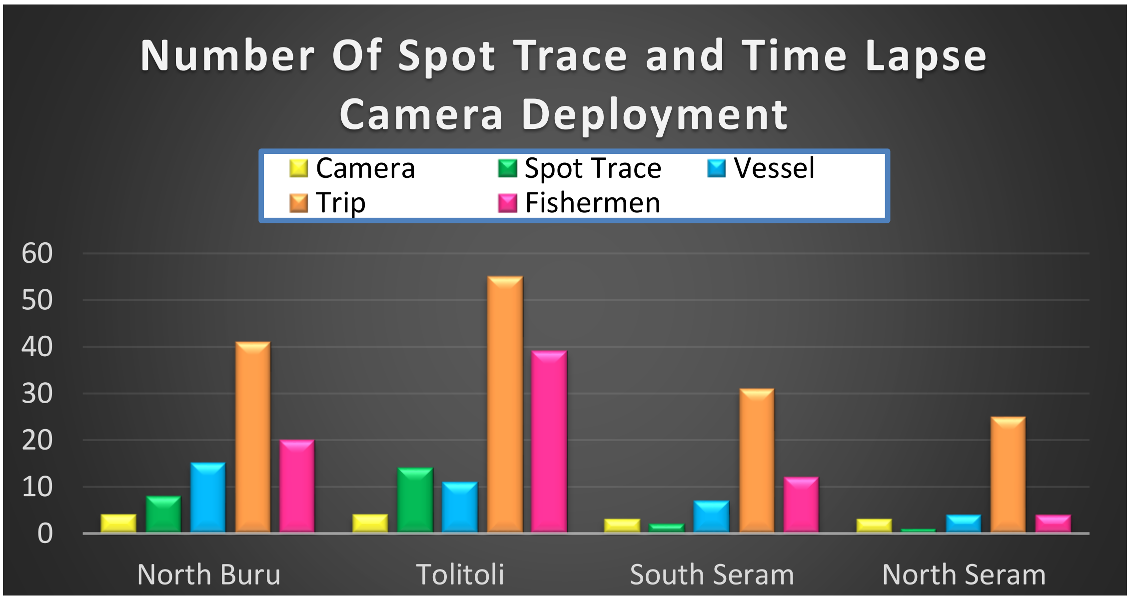

Figure 2. Number of ST and TLC Deployment

Based on the results of time lapse camera analysis, there were TLC trip integrated with ST (53, 3%), Port Sampling (83, 3%), and it is also coverage 6, 7% from total number of fishing trips in four months deployment.

The main purpose of deploying TLC is to figure out how's the ETP interaction with this kind of fisheries and what is the fishermen do to them. There are dolphins, seabirds, and whale sighted during the fishing trip. This ETP sighting is very interesting to be follow up because they are sighted around the fishing ground which is closed with the coastal. It is about fifteen – twenty minutes to go to fishing ground from the coastal.

In order to support traceability and fisheries data, Spot Trace is also deployed in the same vessel with TLC. By combining data track from ST and video from camera, we can identify the FAD's and sighted ETP location. In our port sampling system perspective, we can also verify whether the data collective by interview is accurate. In the rest, the Spot Trace data is used for small scale fisheries management by the government.

In the fact, both of time lapse camera and spot trace are giving more than ETP interaction during the fishing trip, but also capturing a lot of information related FAD's distributing and the marine mammals swimming area around the fishing ground.

We are finally understand the whole process of hand line tuna fishing – How's the artisanal fishermen catching Tuna using traditional methods before their fish come into the processors and the consumer plate.

Challenges

These devices maybe cheap, it is around 290$ for TLC and 120$ for Spot Trace. But there are also challenges based on the lesson learned such as:

TLC	Spot Trace
The staff needs to turn on, turn off, the device (spot trace) manually	Spot Trace battery is easy to be corrosive
No efficient way to analyzing the data (need image recognition software)	The fastest ping setup is every 5 minutes
Need to buy outside Indonesia	GPS system is not working properly when the weather is bad
Specifically designed for the land use, not feasible for marine use	
Need to improve the fishermen awareness to deploy TLC and Spot Trace	
There is no regulation for monitoring on small scale tuna handline fisheries	

Figure 3. Challenges of ST and TLC deployment

Refers to the challenges table above, technically there is no devices that applicable for this fisheries. For now, Indonesian stake holders are advised to use these low cost electronic monitoring in their supply chain to attain the traceability and transparency information on their fishery products. Also next steps, that we are working with partners to look at the interoperability of these devices, what adjustments are required, whether we can work to develop an Indonesian-based option, what is needed for such systems to be scaled up beyond a the few vessels we work with, whether the information is necessary for certifications and market (for example, currently MSC does not require onboard observer information for these vessels because neither national nor international law stipulates the observer requirement).

Acknowledgements Thanks to Supply Chain Department, all of field staff and fishermen who are participated in TLC and ST deployment in North Buru, Tolitoli, North Seram, and South Seram. This study and work was supported by MDPI, The Walton Family Foundation, and Fair Trade Committee.

Best practices for monitoring actions to achieve sustainability of small-scale fisheries. The case of the MSC certified fisheries

Carlos Montero-Castaño

Marine Stewardship Council

Monitoring, control and surveillance (MCS) activities play a key role in the global fisheries management systems in order to assure, not only compliance with legal rules, but also the achievement of sustainability goals.

Monitoring activities have been increasingly developed and improved in the recent decades following new fisheries management needs and supported by great technological advances. This technological progress has facilitated tools to extend monitoring activities to a broader scale in geographical and fleets dimensions, allowing to cover activities in any place of the ocean, from coastal areas to high seas, and of any type of vessels, from large to small-scale. Nevertheless, it is also known the challenges that a proper MCS system implies for certain fleets and fisheries, such as the small-scale fisheries, due to their specific particularities. Small-scale fisheries are usually characterized by a large number of vessels, operating during short-time fishing trips, using several fishing gears, with seasonal target species and geographic variations, with a lower degree of technology in place and a lower level of economic investment. All these factors, together with the fact that small-scale vessels, by definition, have less space to embark onboard observers, create very specific challenges to implement adequate monitoring systems. This particular nature of the small-scale fisheries therefore generates a need to define and implement different approaches, actions and tools to meet fisheries compliance and management objectives.

The Marine Stewardship Council (MSC) is the most recognized global fisheries certification program worldwide, coherent with the FAO Code of Conduct for Responsible Fisheries and the FAO Guidelines for the Ecolabelling of Fish and Fishery Products from Marine Capture Fisheries. The MSC certification program is based on its standard for sustainable fisheries which provides a global framework of fisheries management best practices. The MSC third-party assessment process therefore allows to recognize those best practices actions and to identify and analyse challenges within specific fisheries management system, including those related to monitoring, compliance and enforcement requirements. This paper presents the monitoring actions considered at best practice level in MSC certified small-scale fisheries and analyse the activities developed by fishing operators and managers to improve the performance of particular MCS systems in order to achieve sustainability goals.

The MSC Standard for Sustainable Fisheries is composed by 28 performance indicators structured under 9 components and those under 3 principles. These 3 principles analyse the status of the target stock, the environmental impact of the fishing operations to capture that target stock, and the management system to assure that the target stock and the environmental impacts are well managed and controlled. Within this third principle focused on the effectiveness of the management system, the monitoring activities are considered in the performance indicator 3.2.3 “Compliance and enforcement”, as part of the component “Fishery-specific management system” (figure 1). This particular performance indicator is defined by *“Monitoring, control and surveillance mechanisms ensure the management measures in the fishery and associated enhancement activities are enforced and complied with”,* and includes a specific scoring issue on “Monitoring, Control and Surveillance implementation” for which the best practice level (SG80) is defined as *“A monitoring, control and surveillance system has been implemented in the fishery and associated enhancement activities and has demonstrated an ability to enforce relevant management measures, strategies and/or rules."*

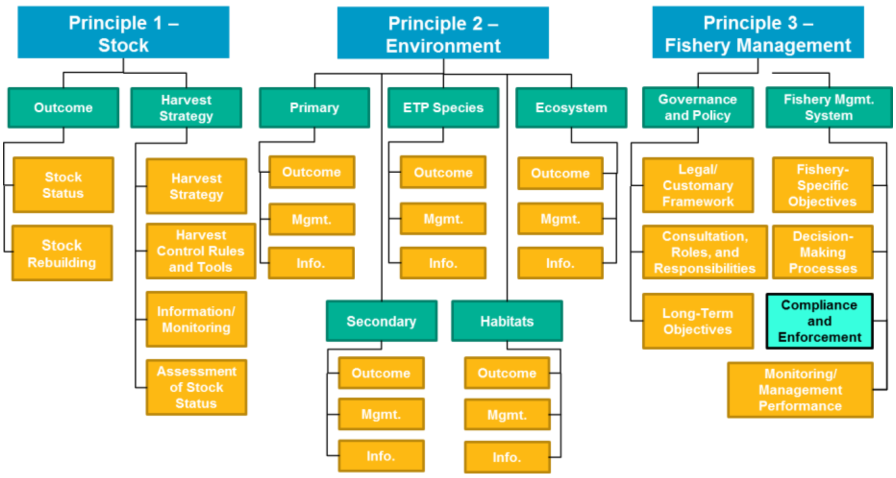

Figure 1: MSC Standard for Sustainable Fisheries (version 2.0)

The analysis here presented is therefore based on the evidences collected by the independent assessment teams on the actions implemented by the fishing operators in order to comply with that best practice level. Among the 76 small-scale fisheries (units of assessment) already MSC certified and analysed in this study, 53 were considered to perform at best practice level or above for their monitoring, control and surveillance systems’ implementation. The different MCS actions were extracted and integrated into homogenous groups following their typology resulting on a full list of actions and those more often implemented by the fisheries (figure 2).

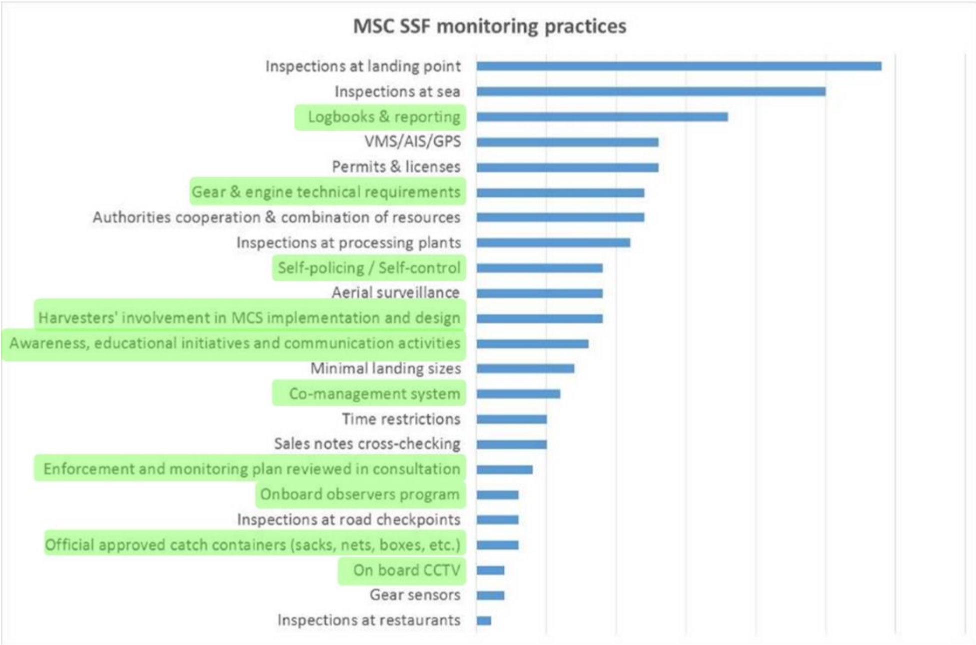

Figure 2: Most commonly implemented monitoring actions in MSC certified small-scale fisheries.

23 different groups of monitoring actions were collected, being the inspections at landing points, inspections at sea and logbooks and reporting, the most commonly implemented. These results show the diversity of monitoring actions implemented in sustainable small-scale fisheries, where combinations of several of these actions allows to achieve the best practice level required to become MSC certified and therefore recognized as environmentally sustainable. The results should be interpreted from a double perspective, on one hand the need for small-scale fisheries to have an implemented MCS system in order to be able to achieve the MSC certification, and at the same time, how the MSC certification creates an impulse to implement some improvements in the monitoring systems. In this sense, the following monitoring actions have been identified as implemented, or at least accelerated, as a result of the requirements to become certified or to maintain the certification: (a) logbooks and reporting, (b) gear and engine technical requirements, (c) self-policing/self-control, (d) harvesters' involvement in MCS implementation and design, (e) awareness, education initiatives and communication activities, (f) co-management systems, (g) enforcement and monitoring plan reviewed in consultation, (h) onboard observers programs, (i) official approved catch containers and (j) on board CCTV.

This study based on the MSC certification tools and process represents a preliminary approach to identify best practice monitoring actions on small-scale fisheries and also allows to visualize how market-based solutions, such as certification and ecolabelling programs, can support, catalyse and strength the implementation of monitoring, control and surveillance systems to achieve sustainability goals.

Open Discussion Session

Q - In these new census to estimate fishing effort you presented, my question for Sebastien is if these fishing vessels are equipped with satellite monitoring control systems?. In Argentina we have developed an algorithm to monitor fishing effort through satellite monitoring

A - For some vessels we have electronic monitoring and we also have a tool to cross check all the data we have: logbooks, monthly fishing forms, sales notes, declarative data, fishing activity calendar surveys, and this is an exhaustive survey. Then we can make some assessments of the completeness of the declarative data that we have, a yes, at the moment we don't have many data from electronic monitoring of the fishing vessels because is just the beginning of the operation. But I think that is good to use this cross validation tool. We use VMS device, all vessels have VMS devices and we use VMS to cross validate the declarative data, logbooks and sales notes.

Q - Very interesting the establishment of small markets to reduce discards and that these discards end up generating income for fishermen. In Argentina, the establishment of markets is complex and very difficult due to strict sanitary and food safety controls, which disincentive these markets, so my question for Steven is how these fishermen managed to improve the performance or how they avoid these controls in order to sell their products to public?

A - I understand that the Health Service comes to the fishing port to perform food safety inspections for people who sell prepared food products. There is a system to evaluate that processing and the products are in accordance with all the necessary sanitary parameters. As for the fish product, it is considered a fresh product and I believe that it is according to the Government's legislation. This helped to facilitate the establishment of the market. Really for San Diego's fishermen the obstacle was processing the fish, they have always been able sell the fish to the public, but it was not allowed to cut and process the fish, so in order to do that kind of processing, the processing of the fish was included in the evaluation of the Health Service.

Q - Question for Carlos Montero from MSC, I found very interesting the way you explained MSC certification and for all the monitoring, including observers and inspections, I can't imagine that MSC has thousands of employees to do that certification, so I imagine that all that work is done through other organizations that already have those employees. The specific question is in 2 parts:

From what I understand, these types of certifications create added value to the fishing products, whatever it is, obviously there are economic incentives for the producer, market incentives. What incentives are there for the people who work in the inspection side, in particular my interest is for the observers. My experience of over 30 years in observer programs has taught me that as long as the value of some fishing product increases and the potential for it to be accepted or not in a specific market, it also increases the pressure on the person who has to do the inspection or monitoring, in particular the observers. then I would like to know how MSC directs or drives those funds where more wealth is created, in particular towards the observers but in general towards the whole monitoring system.

A - Well, for the first question I have to clarify that MSC does not inspect, MSC is not an inspection organization, MSC certifies fisheries and it does it through an independent third party system. This means that there are entities accredited to be MSC certifiers, which with specific evaluation teams collect evidence for each of the fisheries to be assessed. Neither do these evaluation teams embark themselves in the fishing fleets to be inspected. What it is

evaluated in our system is that a particular fishery already has an effective system and what the evaluation team does is interviewing people, collecting information, collecting evidence, etc.
Regarding the issue of incentives, which is a very interesting question, it has two sides. It is true the fact that a fishery is certified by the market incentives, which may be a better prices, new markets, new presentations, etc. Those incentives can increase the pressure on the fishery because somehow it becomes more profitable, let's say then that it may be more interest in going to capture a specific certified species. However at the same time it is true that if the whole system is not maintained, the MSC certificate and the market incentive is lost, because there are annual evaluations and if fishermen do not keep complying with the evaluations, the certificate is withdrawn, then there is a kind of balance.
As for the incentive directly for the observer programs, I see it from a more constructive or positive point of view. However I fully understand that it may exist pressure on observers, or that certifications may induce a pressure on the observer teams (which actually exists), but at the same time there is a shared responsibility in that pressure in the sense that it is the same fishing operator, which is the owner of the certificate who has to ensure that his fishery is well managed and this certainly includes that the observer program works well and also that the data collected by observers are real and are verifiable, then there is a trade-off between that pressure that increases with certifications but at the same time, who presses the observers knows perfectly that the observer has to do a good job because if it does not, the information for the fishery will decrease in quality and that can make the operator to lose the certification.

Q - So in conclusion, the above means that in cases of corruption or cases of pressure on the observer, these events depend on what the operator does. Preventing them depends on the operator himself
A - Yes, I understand that yes, in those cases, besides that the legal and regulatory system gives guarantees to MSC, it depends on the fishing operator itself since he is who owns the certificate so he is who can lose it and is the fishing operator who sells eco certified products

Q - Interesting all the presentations. First of all I would like to say that my questions are more to get information, to get something useful to my country since we are struggling with most small scale fisheries.
First I would like to know a classification of small scale fisheries, I have seen that there are small scale fisheries of 12 meters or 16 meters or more. I want to know if the classification is by boat size or allocation or what other criteria? I think it is good to know, it is useful to have a criterion, to understand the fisheries that we are talking about
Secondly, this is a generic question for all the panelists about how you manage to have the cooperation of the fishermen. It would be very interesting to know about your experience to achieve cooperation from fishermen in the collection of information.
A - In terms of defining small-scale fisheries (the easiest of the questions) in the ICES working group, where there are many European countries involved, there are many definitions and it is difficult to establish what is the correct definition and there is actually no a (single) correct definition.
As long as you try to define a small scale fishery and keep consistent with that definition that is right. To try to standardize across countries is difficult, you may define a small scale fishery in terms of vessel length composition, but I think that there are also other possible

definitions, I think that there is not a correct definition, you have to define your small scale fishery and keep consistent with that definition
A - For data collection purposes we define small scale fleets like those composed by fishing vessels less than 12 m, but it depends on the end users an what you want to do with the data collected. Sometimes small scale fisheries are defined as less than 12 meters for passive gears, only passive gears, but we think for data collection purposes we should focus in vessels less than 12 meters
A - I would give my opinion on the second question on how fishermen could collaborate with data collection. I will broad the question not only for data collection but in general
I am talking about our own experience at MSC. The Leitmotiv of MSC is; it is better together. And I would say that this is not unique for small scale fisheries, but I would say that this is critical for small scale fisheries, and not only for certification. I think that for certification there is a huge incentive for small scale fisheries to work together, and I don't know which is the best definition of small scale fisheries, but in any case, for the survival of the small scale fisheries sector, I would say that working together is the only way.
What we have realized is that the market incentives, not always anyway since it depends on which species, market destination, all these issues, but the market incentives in general play a major role in order to "force" fishermen to work together, because at the end, in many cases they are selling the same MSC species to the same world seller, to the same final consumers. In order to have a sustainable fisheries, good management is needed and management is the same for everyone, so you need to have healthy species, of course it will be different management measures for different fleets, there is no doubt about that, but in the end you need to have a sustainable biological unit, that is what our (MSC) stock population is, and for that purpose you need to have some kind of impact, politically impact and at sea, and to have that political impact you need to bring forces together. So what we have learned from our work in this certification, which is just a small part of the fisheries world, is that there is a huge incentive, as I said, to make people work together in order to achieve those common goals. Because yes, you can have individually a very good practice as a fisherman, but that is not going to guarantee that your target stock or stocks are finally healthy, and you can't only achieve that through political management, let say, that is not enough, that is our view.

Q - Question for Steven from AOI (USA) and anyone else in the panel
You show the example of creating new markets (for perch and mackerel) which is something quite different in Australia. I think the experience you talked about is the perfect example of how changing the economics around how people do buy fish can reduce discards and improve the economic situation at the same time for small operators. I wonder if you can elaborate a little bit further about what procedures were done by producers to create demand and market for those new products.
A - It has been very difficult to get fresh fish in San Diego even though we have a large lobster fishery and other different fisheries as well. I think just presenting the product in this format helped. San Diego has a very wide ethnic base, so the perch for example was a product that not necessarily was attractive to everybody, but if is kept fresh is a very delicate product that members of the community would purchase, it is relatively cheap for a fresh fish as well. And so that was really one of the big success of the market. From my conversation with fishermen is not really about having a whole lot of fish to sale but rather having a lot of diversity. With a lot of diversity they have much nicer presentation of the products to show and that certainly brings in some people to the market and they are willing

to try new products as well. So it was mostly about exposure of the product, just exposing something that it was previously not available to the market. I think somebody (fisherman) just brought in some fish to test how it would work out and he end up selling all of them, so now the fishermen are really trying to keep those previously discarded fish. That fish is not really directed or targeted but is bycatch, and bycatch does have value now, so bycatch is no longer discarded. If the fishermen can bring something in and sell it to the public they will certainly prefer to do that rather than throw it back to the water.

Q - We deploy over 800 observers specially on purse seiners for tuna. My question is for Carlos from MSC on monitoring, since we have issues on safety of observers, there is a concern about it for us in the Pacific. I would like to know whether video monitoring or EMS could be one of the tools to keep observers away from the safety issues that they face in terms of crews or vessel operators threatening them. I would like to know whether video monitoring or EMS can be one of the best tools to monitor MSC and if it is acceptable under EMS scheme?
A - That was a straightforward question and has a straightforward answer, because I can't tell you since we are not prescriptive agency. As MSC I can't say which is the best way to monitor, that is the easy answer.
So I would say yes, but the question is then returned back to you: it is up to the system. EMS is not good or bad itself, is rather how EMS is used?, how EMS is integrated into the program?, into the whole system?. Is EMS used to verify physically the observer?, how that information is used?, how is managed?, all of that, but I would say yes, is absolutely possible because some fisheries have EMS and some fisheries have implemented EMS on purpose, to became or to maintain the EMS certification, so why not?. But again it depends on the whole system. As a tool we can't judge just one fishing gear ore judge just one monitoring mechanism. The assessment team need to see the whole system and how it is integrated and how it answers to the needs of the management plan.

Q - First question is for Ana Ribeiro: You talked about information on this working group, catch working group from ICES, collecting information from different observer onboard, observer programs and data collection programs in small scale fisheries. I was not here yesterday so I was wondering if the Galician Government talked about the small scale fisheries observer programs and also about how many of these programs (observers onboard programs) have you found in Europe during your work. As far as I know, the program here in Galicia has been working for over 20 years or so in small scale fisheries. I am just wondering how common are these observer onboard programs in other EU countries or regions?
A - Spain is very well represented in this ICES working group, there is not a Galician representative, but there is a representative from Basque. The Spanish (Basque) representative leads and is very advocate in observer programs or monitoring programs in small scale fisheries. How common are those onboard programs in small scale fisheries, well we document national observer programs and obviously always it is highlighted the difficulty of having observer programs onboard for the small scale fisheries, the difficulty of sampling and how to sample those fisheries onboard because in the same trip, we have multi gear and multi target species and specially in the southern countries. We have Portugal and Spain pushing and trying to come up with methodologies to set up a design for those observer onboard programs but it is a challenge. At the moment we are trying to document and improve those designs to come up with a kind of best practice, a common best practice that

can be implemented across countries. The group is very much a forum for discussion and sharing experiences to try to understand how or what other countries are doing to document the small scale fisheries and come up with a best practices. However I can't tell how many countries have observers programs onboard small scale fisheries. But obviously there is a tendency of the southern countries facing those problems more than northern countries.

Q - From my knowledge there is a lack of these type of programs (observer onboard programs), I just wonder if you have identified those programs in the working group or several of them?
A - Throughout these years we have identified, highlighted and provide advice on those programs, you can check it at the ICES web page, there is a lot of information on the web page.

Q - I am linking the last comments with Carlos' presentation from MSC, because I always had this idea that there is a lack of this kind of programs onboard, and I was surprised by what Carlos showed; that most, or almost the same number of small scale fisheries on the MSC framework have inland programs and just a little less also have onboard programs. Well I was surprised by that, are those fisheries occurring in Europe or they are from around the world?
A - In order to become a MSC certified fishery, you need to have a good system and as you know, embarking observers in small scale fisheries, depending on the fleet and vessel types, is quite difficult and let see how efficient is embarking observers if you have a fleet of hundreds or thousands of vessels. However the data I showed are worldwide. It is true that a big part of the 53 fisheries I showed came from well managed countries, but I showed a worldwide review.
However what is true, and that is why I insisted in the beginning of my presentation, is that this analysis mainly focused on the compliance and enforcement perspective of monitoring. It is true that for scientific purposes, when we need to embark observers to collect biological data or fishery impacts data, yes, deployments of observers happens but usually, or at least what we have learned from these fisheries, is that these programs are not permanent programs, usually the deployments of 3 months every 2-3 are to learn something that we don't know about impacts of the fishery. But from the monitoring control and surveillance perspective, for me is not surprising if you already are MSC certified. Being certified means that you have a good governance policies, you have good inspection system, so maybe you don't need to have observers onboard in the sense of inspectors or control observers, you can have other mechanisms and is always a combination of several of them. For sure the inspection in the landing point is the key mechanism, that is not surprising, but then you add electronic logbooks, you add VMS, GPS (very simple ones). I would not say is easy, but in the way small scale fisheries perform is not so complex and is true is a challenge in the Mediterranean context or the Galician context, taking into account the huge amount of landing points that we have. This could be challenging but there are other ways.

Q - When you say in your presentation observers onboard, would you include also VMS and GPS or you are talking about human observers in person
A - No when I say observer I mean in person, and I would say that the few fisheries that I have taken into the analysis I showed, have observers onboard that are paid by the companies. So is not the agencies that embarks, is because of any reason the fisheries have decided to embark observers onboard.

Q - Question for Steven from AOI; once the previously discarded fish start being landed and used, it may start getting a better price, then eventually you are going to have some new fishing pressures on it or going to start targeting fish that has limited or not much information available on how it can or it will support fishing exploitation, how do you deal with that condition?
A - I include those fish in my trip report. In my trip report I try to be very comprehensive on all the fish that are landed and discarded. When fish are landed, theoretically there is a paper form associated with that with information, so the discard fish information can be combined with retained fish information to get a kind of a total picture of the fishery. Now, in addition to the landings I do make independent estimates at sea, so we are recording the catch effort and the take of that species as well. I guess that in this way there is a record at the observer level (at sea) and, if fisheries managers see that information, when there is an area of high pressure they will take that information into account and into management decision and they will eventually establish quota for the trip period as well. So a lot of information is getting assembled together, then is the Pacific State whom really determine the quota for two months period. In the process they take into account surveys data, observers data, discards data, they assemble all that information together and if they have recommendations they can establish a quota for that species
A - As someone who work in California fisheries, I would like to add that the State of California does have a process by which landings trigger a management review, so in a situation like that where you have a new species being landed and sold, the State has a process by which they track an increasing landings and it triggers a monitoring framework and a process that is called emerging fisheries, I am happy to talk about later.

<u>Poster Presentations – Extended Abstracts</u>

Challenges of Cramped Quarters and Life on the Fly: Five Years Since Inception of Partial Observer Coverage in Alaska Waters

Bobbie Buzzell, A.I.S., Inc. Observer

North Pacific Observer Program

In January of 2013 the North Pacific Observer Program (NPOP) began requiring, for the first time, partial observer coverage (i.e. vessels selected for coverage on a trip-to-trip basis) for vessels in the 40-59 feet range. The restructuring of the Observer Program established a method to attain statistically defensible data through a random selection process. We, as observers deployed in the partial coverage fleet, are met with several challenges that have required focused refinement in adaption and communication for the program as a whole. These challenges include frequent travel, adjusting sampling designs for the “smaller” fleet, discussing sampling needs with vessel crew unfamiliar with the observer program, and cultural and communication barriers (e.g. Russian American longline fleet). Since inception of the program, many of us have accumulated invaluable experience and perspective on how to combat these challenges and how we have evolved in our profession.

The PC program covers fishing ports stretching from the southeast to as far as the Aleutian and Pribilof Islands in the state of Alaska. Extensive and speedy travel is often necessary in order to reach many of the vessels in a reasonable amount of time. We frequently shuffle from port to port or vessel to vessel, which can often be burdensome with heavy sampling gear and personal luggage in tow. Although we are often notified at least a day or two in advance before travel, it is not uncommon for assignments and travel arrangements to change the same day of travel. Optimizing what we pack and how we pack can greatly influence the convenience of our travel. Field offices for gear replenishment in Anchorage, Kodiak, and Dutch Harbor are often out of reach for many of us and we must prepare for the likelihood of not being able to reach one of these stations during our deployment.

PC observers could deploy on upwards of 19 trips in a 90-day deployment covering three types of gear in the groundfish fishery-pot, trawl, and longline. Considering the high degree of variability in deck layout and the number of crew (1-5, including the captain), accommodating one extra person is often a point of contention for these vessels. In order to relieve some of this strife, observers quickly adapt to the space provided for living and sampling so as to interfere as little as possible with crew operations. Questions we may ask crew might include: Is this a safe place to work? What areas are the most accessible? Are these methods suitable for collecting everything I need? Are there other available and viable options? Often times we must adjust and modify sampling protocols originally used for full coverage vessels (vessels requiring 100% observer coverage). Working through these questions and understanding the parameters of our work environment can often be exhausting; as soon as we have perfected our sample design we disembark to await a new assignment that may be completely different. However, because we must frequently start from "square one" trip after trip, we are granted many opportunities to improve upon ingenuity and discover more streamlined ways to collect the same amount of data.

Second only to safety, monitoring for and documenting compliance infractions and suspected violations are incumbent to all NPOP observers. Unfortunately, this role commonly stereotypes us as "government eyes" purposely looking for violations, an exaggeration that leads to a misconstrued understanding of the goal of having observers at sea. It is ultimately the observer's decision whether or not to communicate compliance issues directly with vessel personnel, as each vessel is unique in situation, environment, and crew; but depending on the observer's comfort level and situation, compliance issues can potentially be a good opportunity to educate and provide awareness, especially PC vessels. Some captains encourage observers to bring issues to their attention, but others can be more timid of initiating this conversation with the observer. We try to confront issues without appearing authoritative or too overbearing, but observers can struggle with the "how" and "when" to discuss compliance issues because of the potential conflict it may cause for the rest of the trip. Each issue must be handled on a case-by-case scenario and with a degree of sensitivity. During the safety orientation is usually a good opportunity to discuss compliance and establish an open line of communication with the captain. Doing so can alleviate many of the "taboo" attitudes set by the fleet and creates an open dialogue on how to approach compliance for the entirety of the trip.

Along with open communication, taking simple steps such as respecting house rules and cleaning up after yourself goes a long way towards a more peaceful and professional coexistence with vessel crew. Again, this is another topic usually discussed during or shortly after the safety orientation. This holds especially true for the Russian-American longline fleet mainly based in the central Gulf of Alaska. Many of these vessels follow traditional Russian Orthodox teachings and can be strict about what guests may use in the galley. The stove and oven are the most common appliances unavailable to guests but on other vessels the whole galley can be off limits. Disposable plates and cutlery often help avoid the restriction of using their silverware. Coordinators and other observers will always suggest you bring your own food in case the crew is fasting and meals are simple and infrequent. We do our best to respect these customs, but over the last few years the Russian-American fleet has also had to heavily adjust to our presence and cope with the new requirements of the observer program.

The PC observer category is still quite new in respect to the rest of the Alaska observer program (observers first placed on domestic vessels in 1986). The challenge of any observer, globally, is to serve as an ambassador to his/her program and to fisheries management in general. The PC program in Alaska provides a great example of how we can improve upon relations between management and industry. Good ambassadors know how to communicate effectively, enjoy cultural diversity, and are integrated with their environment. Families manage many of these vessels, and staying on these vessels means we are essentially staying in someone's home. In this setting, our rapport significantly improves when we exhibit an effort in cleaning up after ourselves, helping with dishes, and minimizing our hindrance on deck. Over time, the original contention of hosting an extra person is replaced by a more positive reception to the entire program. Just because observers must adjust and sometimes scale back sample collections from previous standards does not mean data is or should ever be compromised. On the contrary, PC observers must be more involved and in some ways can have greater influence over sample design setup and implementation. As observers continue to propagate an optimistic experience in this "observer inexperienced" fleet, we can also continue to pave the way for a more cohesive relationship between industry and science-driven management.

Abstracts of presentations that did not provide Extended Abstracts

San Diego Artisanal Fisheries, the "Tuna Harbor Dockside Market", And Zero Discard

Steven W. Todd

West Coast Groundfish Observer Program, USA

Conscientious consumers invest greater effort to procure healthy, sustainable, and environmentally responsible food products. The "Slow Food Movement", farm to table restaurants, and the ever growing number of farmer's markets in San Diego evidence this development. As consumers cultivate relationships with the producers and their products, their food knowledge assists them

in making choices that favor the local, seasonally caught and grown products available at farmer's markets throughout the greater community. San Diego fishermen have also taken notice of the local demand, and have united to form a seafood only public market merchandising products taken from local waters.

Commercial fishing in San Diego dates back to the early days of statehood. Local catch was likely easy to obtain in those times, but not so much now. Corporate wholesalers now move the bulk of seafood around town, most of which is imported. An addition to this model came in 2014 when a temporary permit for a fishermen only farmer's market was issued to help organize San Diego fishermen. Infrastructure and an outlet for their product was needed to maintain and improve their livelihood, and the public wanted access to fresh and local catch that was previously unavailable. The advent of the "Tuna Harbor Dockside Market" was created to fill this vacant niche. Local fishermen can now promote and display their products for sale direct to the public. Catch unsaleable on the wholesale market have proven to be highly desirable in this arena, and include fish that were formerly considered discard. Fish with low wholesale price or market absence, like Mackerel and Surfperches, are now targeted and retained for sale. They are specifically solicited for by the diverse ethnic public that supports the market.

Balance between economic and biological sustainability are vital for the future of our national and international fisheries and fishermen. Nascent from the Tuna Harbor Dockside Market experience, "The Pacific to Plate Bill" (Assembly Bill 226) was created. Signed into law October 8, 2015 by Governor Jerry Brown, AB226 has streamlined and defined the regulations for implementation of fishermen's farmer's markets in California. Guidelines for public seafood markets operating as food facilities were established, and allow fish to be cleaned for direct sale to the public. This market model offers greater utilization of catch by reduction of discard, and can provide a solution to reduce pressure to heavily fished stocks both nationally and abroad.

Identifying fishing behaviours of inshore fishing vessels targeting crabs and lobsters around Scotland

Tania Mendo, Smout, S., Pasco, G. Course, G, James, M.

Scottish Oceans Institute, University of St. Andrews

Spatial management of the marine environment should underpin sustainable management of the ecosystem including vulnerable and dependent species such as marine mammals, commercial resources such as fish, and human communities that depend on the marine environment for their way of life. Management measures may result in restriction of fishing effort e.g. through closure of areas. To predict impacts of such measures on people and marine species, it is essential to know how fishing is currently distributed and how intense levels of fishing are at local scales. However, the distribution of fishing activity in inshore areas (often carried out by small scale fishing vessels) is currently not well known, though tracking data from AIS and GPS systems are increasingly available. Tracking data can be analysed to indicate the location and speed of boats in time and space, but it is not possible to directly infer where boats are fishing or where they are engaged in other activities (such as travelling to and from their fishing grounds). Patterns of movement associated with particular types of fishing may be detectable e.g. characteristic patterns of speed and turning behaviour when creels are deployed or retrieved. We will present initial results of an analysis of boat movement data for which there is matching on-board validation of activities during a fishing trip, allowing us to model the association between movement patterns and fishing. We then use a cross- validation procedure to evaluate the model performance by splitting the ground-truthed data into two datasets. The first dataset is used to estimate model parameters and the second, to validate the models by estimating model performance, by assessing the percentage of events in which the predicted behavioural state corresponds to the true behaviour.

AIS data to inform small scale fisheries management and marine spatial planning

Tania Mendo, Mark James, Esther L. Jones, Kyla Orr, Ali McKnight, John Thompson

Scottish Oceans Institute, University of St. Andrews, Scotland

Automatic Identification Systems (AIS) are collision avoidance devices used on- board both commercial and leisure craft. These systems report the position, track and speed of the vessel through Very High Frequency radio transmissions which are accessible to any suitable receiver. This paper explores the potential to use AIS data to inform small scale fisheries management and marine spatial planning. First, the propagation and reception of the line of sight AIS transmissions was modelled around the coast of Scotland to identify areas where the use of AIS may be compromised. Using open source Geographic Information System and relational database software, computationally efficient methods of processing and analysing AIS data were explored. Three months of AIS data derived from 274 Scottish small scale fishing vessels were used to provide spatio-temporal analyses of trip duration and distance travelled, location of fishing activities, and vessel dependency on fishing grounds.

The coverage, opportunities and challenges of using AIS are discussed together with broader applications and future developments.

Providing quality and affordable advice in artisanal fisheries: the barefoot fisheries advisor in the Galician (Spain) co-managed turfs

Gonzalo Macho, Andrés Simón, Sebastián Villasante and José Molares

Vigo University, Spain

Many authors have pointed out the need for simpler assessment and management procedures for avoiding overexploitation in small-scale fisheries. Nevertheless, models for providing scientific advice for sustainable small-scale fisheries management have not yet been published and discussed in the scientific literature. Here we present one model; the case of the Barefoot Fisheries Advisors (BFAs) in the Galician (NW Spain) co-managed Territorial Users Rights for Fishing. This model is applied in the Galician shellfisheries; 8,500 fishers distributed in 62 fishers' organizations and targeting more than 40 sedentary species (bivalves, gooseneck barnacle, gastropods, sea urchin, annelids, sea anemones, and seaweeds). In this work we have analysed the historical development and evolution of roles of this novel and stimulating actor in a decentralized fisheries management system. BFAs roles include draw up management plans, stock assessments, maintenance of fishery

databases and indicators, advice to the fishers' organizations, communication with the fishery administration, development of innovative projects… As we will show based on information from the razor clam and gooseneck barnacle fisheries, the Galician BFA model allows the provision of good quality and organized fisheries indicators, at an affordable level for artisanal fisheries, to facilitate and support decision-making processes. The BFAs also build robust social capital by acting as knowledge collectors (e.g. Local Ecological Knowledge) and translators between fishers, managers, and scientists, allowing this way a more effective communication when implementing fisheries policies. BFAs are a combination of fishery biologists, experts in stock status and extension workers, who, directly hired by the fishers´ guilds, are committed to support fishers and manage the fishery from a sustainable (social, ecological, environmental and economic) point of view. The BFAs have become along 20 years of existence in key actors in the artisanal fisheries management of Galicia and a case for learning lessons.

Recent Analytical Approaches and Advances for Addressing Ecosystem Based Fisheries Management of Southeastern Reef Fishes

Jordan Taylor

Galveston Observer Program Gulf of Mexico Reef and Shrimp Observer Program, USA

Species exhibit spatial variability and distribution in abundance through time (Dunning et al. 1992). Variation in species distribution and abundance can result from: habitat patchiness, predator interactions, availability of prey, recruitment of the next generation, seasonal migration patterns, and fishing effort (Levin 1992; Bacheler and Ballenger 2016).

Traditionally, stock assessments have been analyzed using a single-species approach to management, where biological interactions between targeted species and their predators, competitors, or prey are largely ignored. Since 1990, these assessments and management policies have shifted from the traditional single-species analyses to approaches that attempt to incorporate whole ecosystems into policy decisions, known as ecosystem-based fisheries management (EBFM) (Larkin 1996; Pikitch et al. 2004). Multispecies analyses address ecological interactions, food web/ trophic links, and community compositions, theoretically providing a more comprehensive understanding of overall fishing impacts on a single stock and the ecosystem that supports that stock (Link et al. 2002; Latour et al. 2003; Cury and Christensen 2005). In recent years, more robust analytical techniques have been developed to understand these whole ecosystem interactions. Spatially explicit models have been an invaluable tool for addressing EBFM, because they incorporate ecological interactions with the effects of space. Spatially explicit non-linear modeling has been used to report the distribution of the Arrowtooth flounder, Atheresthes stomias, which is affected solely by water temperature rather than commercial fishing effort (Ciannelli et al. 2012). Similarly, Bacheler and Ballenger (2016) documented changes in the spatial distribution of sizes and catches of Black Sea Bass in the Southeastern US at smaller spatial scales compared to larger ones using variable-coefficient modeling. Another approach, canonical variate analyses (CVA), has been useful in elucidating the forage fish guild structure in six reef fishes of the US South Atlantic Bight through spatial and resource dependence using morphological features (Michael and Smart 2017). These robust and rigorous analyses provide more accurate, non-biased bycatch estimates, as well as abundance and distribution estimates of target reef fishes over space and time by incorporating ecosystem-based interactions. Recent technological advances, such as long-term video monitoring, have also provided additional means for collecting spatial and temporal data. Vessel monitoring systems (VMS) provide accurate fishing effort estimates and real-time data when observers cannot be present (Lee et al. 2010). These new advances and analytical techniques have revolutionized not only how data can be collected, but also how it can be analyzed, which is an important step towards creating holistic EBFM regimes.

Session 4. New approaches to analysing monitoring data

Leader: Elizabeth Scott-Denton

As knowledge and technology increases, we have adopted new tools and strategies to analyze data from observer and Electronic Monitoring programs. Moreover, other data sources including, but not limited to, environmental, biological and socio-economic data have recently been integrated into observer and EM assessments. These new strategies have reduced bias and uncertainty and have led to better bycatch estimates, bycatch reduction technologies, more robust single and multi-species stock assessments, and holistic ecosystem and probabilistic modelling approaches. In this session, we explored how these new and innovative approaches to analyse data from fishery observer programs and EM are being used in making management decisions.

Oral Presentations - Extended Abstracts

Setting review rates: using existing data to help determine the business rules for an audit-model electronic monitoring program

Andrew W. Jones, Daniel W. Linden, Brant M. McAfee, Nichole A. Rossi, Michael C. Palmer, John J. Hoey, Amy S. Martins

NOAA Fisheries, USA

Audit-based electronic monitoring (EM) programs, where discard information is primarily derived from fisher's self-reported estimates and a subset of which are verified through video review, represent an attractive emerging option for monitoring fisheries. Many of these programs are in preliminary phases and manager tasked with cultivating them face a number of tough questions. One common but difficult topic is how to best determine the business rules (e.g., the percent of video to be reviewed) for these programs. This is of particular importance to these emerging programs because specifics like the rate at which video is reviewed are directly tied to data quality and total monitoring costs.

Here we present some quantitative analyses currently being considered in formulating business rules for an audit-model EM program in the northeast Multispecies Groundfish fishery where discard estimates are highly contentious and there is interest from managers and stakeholders in advancing the state of monitoring. Specifically, we highlight how the region is focusing on a set of questions related to the percent review rate as well as the threshold for alignment between self-reported and independent trip summaries. We first discuss examples of specific questions we are investigating such as: ‘how many efforts might fail given different thresholds?’ and ‘how does an audit affect our estimates of discards?’. We then delve into the methods we are utilizing to develop preliminary answers to these questions, outlining both the data sets used and the types of simple simulations we are performing. We highlight high-level results from analyses addressing each separate question.

For simulations exploring how video review rates and weight alignment thresholds affect the proportion passing efforts we find that the percent passing efforts depends on the size of the threshold. As expected, a greater number of trips passed when the absolute magnitude of the threshold was larger. However, we find that this relationship was nonlinear, and that its shape is related to a number of factors. These factors include the data set that is used, whether weights are summed at the trip or haul level prior to the comparison, and the species complement included in weight comparisons. Finally we find that there is a clear pattern of decreasing variability (among simulations) in the percent passing efforts at higher review rates. This decrease in variability is most pronounced between a review rate of 10% and 20%, and decreases in variability are quite small when increasing the rate to more than 50%.

For our investigations into the effect of different review rates on total estimates of discards we find a number of interesting patterns as well. Specifically, we find that the error in the total estimated discard weight (i.e., mean absolute difference from a census based estimate) increases with decreasing audit rates, and that the shape of this relationship varies greatly among the species considered. This means that the percent error (again, from a census) included in an estimate of total discards derived using the audit method will likely will likely vary among species. This also indicates that the rate at which the error in total discard estimates decreases with increasing video review will also vary depending on species that is considered. Perhaps most interestingly we find that the percent error for many simulated levels of audit was less than for a simulated ratio based estimate of total discarded catch. Perhaps most importantly, we find that at video review rates greater than 20% the audit method produces a lower level of error than the ratio method for all but three species considered. While potentially significant, this finding is preliminary and will require additionally consideration to confirm.

In conclusion we suggest that our approach is to synthesize across these distinct analyses to find rules or thresholds that seem advantageous. Taken together, our preliminary results from this work suggest that an audit-model program will likely be able to operate with less than 100% review. This work suggests review rates and weight tolerances varied across analyses, but that there was often limited quantitative gains in increasing the review rate above 50%. Based on these preliminary results we are beginning to implement an audit-model EM program in the northeast Multispecies Groundfish fishery. We aim to provide a clear example of an approach to using the degree of alignment between self-reported and independent data to determine the percent review rate in hopes that this could be applied in other regions seeking to implement audit-based EM programs.

Grading machines - automatic fish weights for the people

Joseph Ribeiro, Jon M. Elson, Leah Winpenny and David L. Maxwell

CEFAS, UK

Background

For around half a century there has been an English onshore sampling programme that collects length, age, sex and maturity data from landings at major ports in England. The current programme is coordinated by Cefas with the aim of collecting data from the landings of around 60 fish and shellfish stocks. In most instances, a subsample of the data is collected, and these data are raised and converted to fleet catch numbers and weight at age for stock assessments.

At many of these ports landings are now processed using graders where every fish is weighed and categorised by weight for sale. There is clear potential for these Remote Electronic Monitoring (REM) data: both to cost-efficiently contribute to enhancing data collection needs for stock assessment but also to open up a new data stream, but we need to develop expertise and answer fundamental questions on the processes, practicalities and potential applications.

Aims & objectives

The following objectives were outlined for this project:

- Establish feasibility and method of obtaining REM weight data.
- Assess suitability of REM weight data to meet requirements, including costs & benefits.
- Assess role REM weight data can provide in stock assessment inputs.
- Seek novel scientific uses of REM weight data, e.g. monitoring spawning condition.
- Investigate joint project with markets and grading companies, and business opportunities for data products and expertise in processing REM weight data.
- Scope out if and how REM weight data could combine with market-based camera systems, on-board CCTV data and electronic logbooks for future fisheries monitoring.

Having access to a high frequency source of weight data will enable the data quality, coverage and efficiency of our landings sampling to be evaluated and demonstrated. This project will qualify the value of the resource and offer an opportunity for the industry to provide core biological data for stock indices fleet activity for the conservation of their fisheries and even manage their activity.

Delivery of objectives

Objective 1 Data were successfully obtained for all graded vessel landings to Newlyn for Feb-June 2017 and from two vessels at Brixham for Jan-April and Jan-June 2017. This provided a good volume of data for the project, sampling 973,500 fish from over 200 landings into Newlyn. Markets at Plymouth, Looe, Grimsby and North Shields also have Marel grading machines so should have the same data format, allowing the methods we have developed to be transferred. Data were downloaded directly from the system at Newlyn and data were emailed from Brixham. For routine access, transfer via an FTP server may be feasible. Verbal agreement to use the data in-house was given for Newlyn and by written consent from two vessel owners at Brixham so further written agreements and some guarantee of access to REM data will be needed on a port-by-port basis.

Objectives 2 and 3 We have programmed a method to process the data, then combine with official landings data and data from the ongoing market sampling programme. An evaluation of the data coverage and quality, based around ICES best practice guidelines indicate that the length distributions from the graders and market sampling were comparable. The two data sources have different strengths: grader data had considerably more fish weighed and more landings sampled; market sampling had more species, better coverage of small landings including those from smaller ports. Grader data also revealed some errors in the raw market sampling data.

There is uncertainty in EU and UK fisheries data requirements after EU Exit but this data allows scope for new approaches. We can now convert grader data to the length-based format currently used for stock assessments, grader data cannot fully replace market sampling but can provide a cost-effective component of an integrated monitoring approach. The length data currently collected is converted to weight at age and these data could negate that process.

Objectives 4 to 6 The main novelty of grader machine data is the high sampling resolution which can track changes in weight or estimated length distribution of landings in time (e.g. month) and space (ICES rectangle; Figure 1 below).

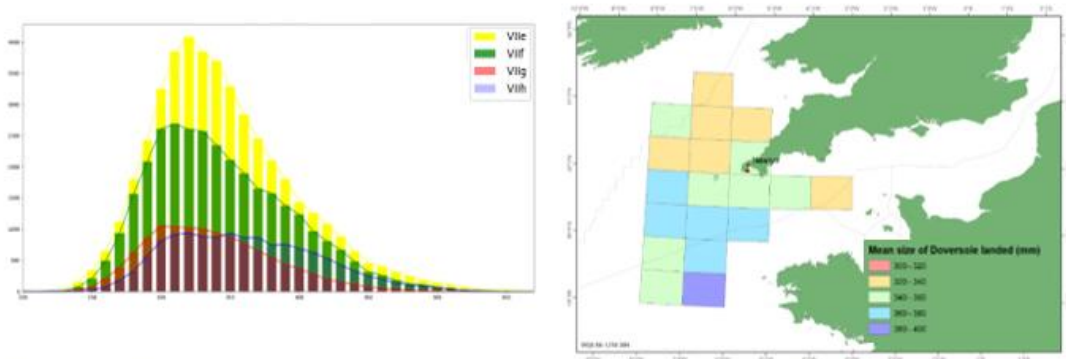

Figure 1 a) Left: Estimated length distributions for Dover sole landings processed at Newlyn between Feb-June 2017, by ICES area; b) Right: mean length of these sole landings by ICES rectangle.

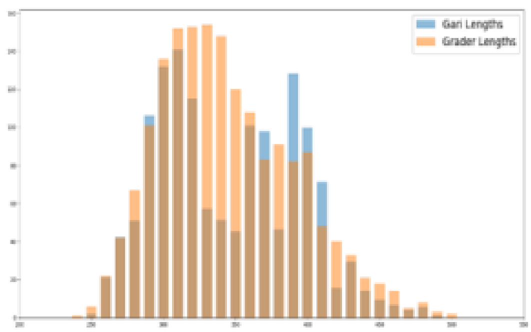

Figure 2, left: Length population distribution for a Dover sole landing at Brixham: Market sampling data (blue) and grader (orange) sampling data. An incorrect total weight has been entered for one market category, and the mistake has been identified by comparison with grader data.

Building trust and demonstrating the value of sharing the data has been a gradual process. Discussions on uses of the data have been held with port staff and market operators. Follow-up meetings with the Cornish Fishermens Association and Southwestern Fish Producers Organisation (SWFPO) in April 2018 and getting further feedback has ensured an extension to the data exchange agreements and an expansion to include more of the fleet in Brixham.

Continuation of this work fits within a new project, SMARTFISH, enhancing catch monitoring programmes using advanced technology for fishers and scientists.

The grader data could enhance the QA on market sampling data.

Figure 2 compares the lengths from a sole landing as recorded by a market sampler and by the grader machine. An error appears to have been made by the sampler recording the total landed weights of one of the market categories, and as a result a large proportion of the fish between 320-350 cm are missing from the market sample. This deficit is apparent in the difference between the weight landed and submitted by the skipper (762 kg) and the sum of the sampled weights (568 kg). Grader data can provide the missing information on which lengths may be underrepresented, and would prevent these data from being used, uncorrected, in the stock assessment.

The future

The project has developed understanding of grading machine data and produced methods to collect, process and combine it with other fisheries information to assess data quality and coverage. The current analysis has focused on the Newlyn sole data and although the different sources for size data are comparable the data for other species appears less so and that needs further investigation. It would enhance the current programme and could provide an opportunity for Cefas to reallocate the current resource to improve the coverage of other fisheries and our use of length, weight and age relationships.

Overall, the design and analysis to combine multiple sources of standard and electronic fisheries monitoring data, and having the data systems to support this, is an important area for further development.

Spatial analysis of data from on-board observer program: towards discard mitigation for a French otter trawl fleet

Fabien Pointin [1,2]*, Marie-Joëlle Rochet [1], Yanis Souami [2]

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Introduction

The 2013 Common Fisheries Policy introduced a Landing Obligation (LO) to eliminate discards in European fisheries. To comply with the resulting constraints, fishers' interests are to reduce discards by using more selective fishing practices, such as avoidance behaviours. Knowing spatial patterns of landings and discards could help to identify fishing zones to be avoided (i.e., high discards) or to be favoured (i.e., low discards and medium/high landings).

The French on-board observer programme (Obsmer) has collected data on fisheries landings and discards under the European Union (EU) data collection regulation (2002-2008) and the subsequent data collection framework. Using these data, modelling studies have explored the spatial distribution of landings and discards, but statistical assumptions have been used to address the non-random spatial distribution of data, which may cause errors in the parameter of interest. An alternative non-model-based mapping method using nested grids can be applied (Pointin *et al.*, 2018). This method is expected to address the spatial non-randomness of data by adjusting the size of each grid cell as a function of the number of observations therein.

The idiosyncratic nature of discards and mitigation strategies requires these strategies to be developed on a case-by-case basis at the scale of a group of vessels. The potential of the nested grid method is thus established by exploring the spatial and temporal distribution of landings and discards with a particular focus on choke species for a French otter trawl fleet from Boulogne-sur-Mer over the period 2011-2016.

Materials and Methods

Data

First, the Obsmer data were used to create nested grids, estimate discards and evaluate the resulting maps. These data included information on landings and discards (in number, size and weight) per species for each fishing operation (FO) observed on-board individual vessel; fishing trip characteristics were also included (e.g., trip duration, landing port). Second, fisheries statistics were used to estimate landings and evaluate the resulting maps. Based on official data (logbooks, sales and fishing effort data), the most likely estimates of total landings (in weight and value) and fishing effort (in days-at-sea and fishing hours) were provided by individual vessel, fishing sequence (i.e., a combination of day, gear, and ICES statistical rectangle) and species.

Nested grid method

From the average geographical coordinates of each FO, the nested grids were constructed based on an iterative process of cell division: starting with a coarse regular grid, each cell was divided one or several times according to the number of FOs therein. The division-based procedure required a maximum and minimum FO threshold for each cell size. Based on a level of precision set to 0.35, FO thresholds were determined as described in Pointin et al. (2018). Total landings and discards were then estimated over the whole study area, and were distributed proportionally in each cell depending on local (i.e., per cell) estimated proportions computed from the observed FOs. Finally, the resulting maps relied on quantitative and qualitative indicators to evaluate the representativity of the Obsmer samples and the spatial distribution of FOs within each cell.

Results

At Boulogne-sur-Mer, the French otter trawl fleet was found satisfactorily covered by the Obsmer programme. Sampling effort was found temporally consistent with fishing effort between years and between months, and was also found spatially consistent with fishing effort and landings. To identify fishing zones or periods to be avoided or to be favoured regarding choke species, the proportions of horse mackerel discarded were mapped according to the period of the year (Fig. 1).

Discussion

For the French otter trawl fleet, the Obsmer sample was representative of vessel sizes and fishing activity, and FOs were randomly distributed in almost all cells. Results showed that several fishing areas were characterised with high discarded proportions, and avoiding them could decrease horse mackerel discards in the eastern English Channel.

The grid fineness and the estimate precision are found to depend mainly on the density and variability of on-board observer data. Moreover, an extensive coverage of fishing activity in space and time, and of all fishing vessels, is required to produce meaningful maps for which all quality criteria are met. The method is easily implemented, and additional data sources can be integrated, such as the volume of the previously discarded species which will likely be landed under the Landing Obligation.

References

Pointin, F., Cornou, A.-S., Prod’homme, R., Taupin, N., and Rochet, M.-J. 2018. A method to address the non-random spatial distribution of on-board observer data to map landings and discards. Fisheries Research, 199: 242–251.

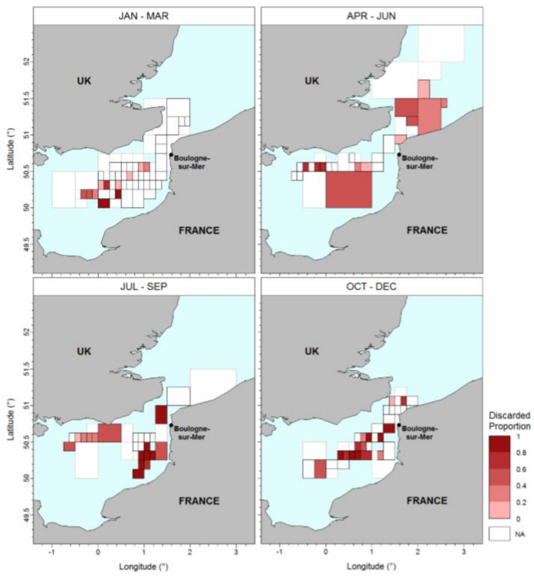


Figure 1: Discarded proportion of horse mackerel for the French otter trawl fleet based in Boulogne-sur-Mer from January to March, April to June, July to September and October to December. Data were pooled from 2011 to 2016. Black (grey) lines define cells with (in)sufficient amounts of FOs to make estimates with a precision level of 0.35.

Uniting electronic monitoring and observer data to improve management of the US West Coast groundfish fishery

K.A. Somers, J. Jannot, J. McVeigh

NOAA – NWFSC – West Coast Groundfish Observer Program, USA

In 2011, catch shares management was implemented in the US West Coast groundfish bottom trawl fleet to move towards individual catch accountability, primarily for those species with individual fishing quotas (IFQs). These quota account for all catch, whether landed or discarded, so the West Coast Groundfish Observer Program (WCGOP) placed observers on 100% of fishing trips to monitor at-sea discards. In 2015, to explore the potential for reducing the financial burden of monitoring costs borne by industry, electronic monitoring (EM) systems were adopted in-lieu of observers by some vessels. This subset of the fleet is no longer required to maintain 100% observer coverage and is instead randomly selected to achieve ~30% observer coverage, which is focused on biological and supplementary data collection. Rather than viewing observer and EM programs as opposing forces, this talk presents three specific ways that we have integrated these two programs and datasets to continue to provide total catch estimates for all species and essential biological data.

First, we have assessed the strengths of both EM and observer data to identify the most appropriate source to utilize in calculating discard estimates for each species impacted by the fishery. EM provides excellent estimates of at-sea discards of a subset of IFQ species that are identifiable on video, as well as total weight estimates of unsampled, operational discharge (Figure 1). However, quota species account for only ~75 of the more than 300 species encountered by the bottom trawl fleet, which include both actively managed groundfish species and currently unmanaged nongroundfish species (Figure 1). Much of the non-quota groundfish species discards consist of Ecosystem Component Species (ECS) and other groupings that the Pacific Fishery Management Council (PFMC) has identified as likely to be increasingly targeted in the future. Discard estimates for these species in the present will serve to sustainably manage the fishery as it evolves. The high percentage of non-groundfish catch discarded is comprised of invertebrates, sharks, and non-managed flatfish. Observer data remains the only source of discard rates for these components of the ocean ecosystem, which are essential to estimating fleetwide at-sea discard amounts and understanding overall fishery impacts.

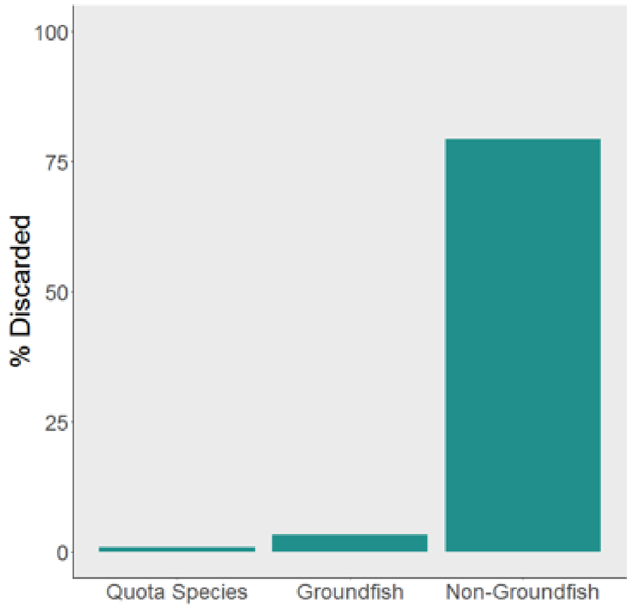


Figure 1. Proportion of total catch discarded at-sea in the 2015 and 2016 catch shares EM bottom trawl fishery by management grouping.

Second, we have recognized how differing rules in the EM fleet require new sampling protocols for observers. Prohibitions on which species can be discarded while using EM resulted in the regular landing of unmarketable species, which are frequently undocumented on landings receipts. Without the deployment of observers, the catch of these “shoreside discards” would be under-estimated and unknowable. We found that catch in 2015 and 2016, catch would have been underestimated by ~38 mt (Figures 2 and 3). While this amount is relatively small, half of that catch is comprised of ECS, including 15% of the total catch of giant grenadier across all sectors of the fishery (Figure 3). By working with fishermen to identify this portion of the catch, observers have been able to account for the weight and composition of these species at sea.

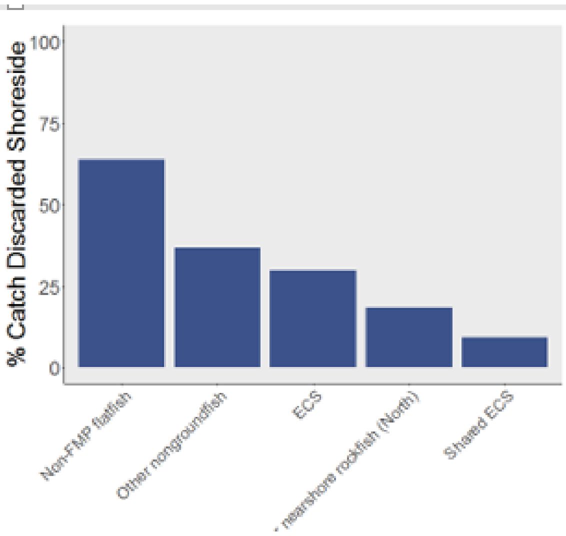


Figure 2. Proportion of catch discarded shoreside in the 2015 and 2016 catch shares EM bottom trawl fishery by management grouping.

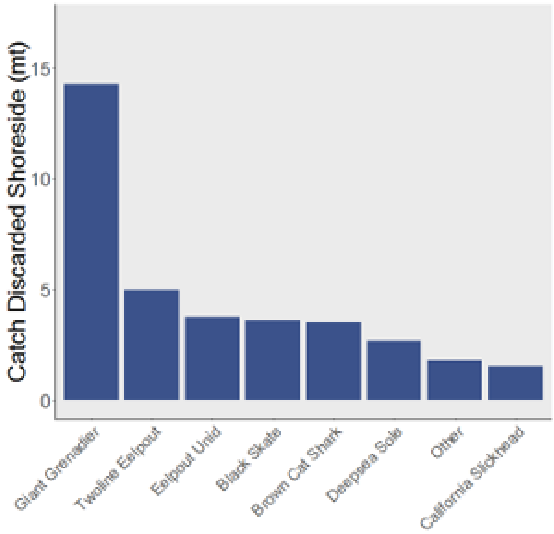


Figure 3. Weight (mt) of catch discarded shoreside in the 2015 and 2016 catch shares EM bottom trawl fishery by species.

Finally, observers continue to collect valuable biological and genetic data necessary to meet the needs of stock assessments and inform legally-mandated biological opinions. These data are often either completely unavailable from EM and shoreside monitoring or not associated with specific temporal and spatial attributes. For quota, non-quota groundfish, and non-groundfish species, WCGOP observers collect length-frequency data. This data collection typically focuses on closely managed species, as stock assessors use length-frequency tables to estimate population structures and managers use the same data to inform policy and regulation decisions.

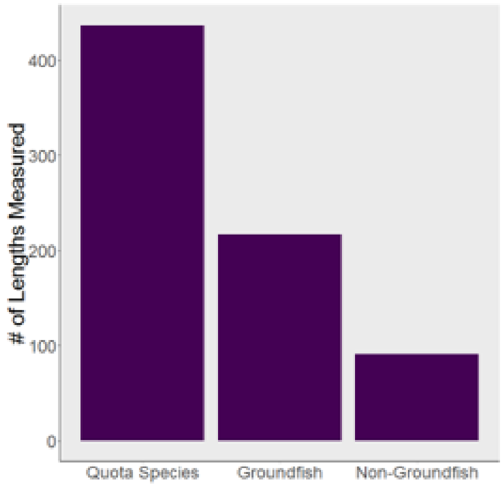


Figure 4. Number of lengths measured by WCGOP observers in the 2015-2017 catch shares EM bottom trawl fishery by management grouping.

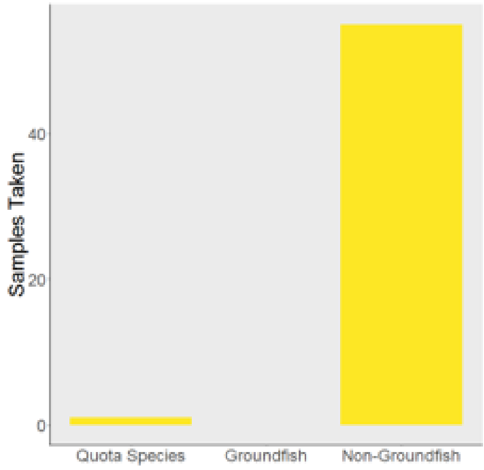


Figure 5. Number of biological samples taken by WCGOP observers in the 2015-2017 catch shares EM bottom trawl fishery by management grouping.

Additionally, observers collect biological samples. A majority of these samples consist of corals and sponges, which has created a dataset of known presence locations that were essential in recent decisions to identify Essential Fish Habitat and alter spatial closures to fishing. Observers also collect otoliths used for age estimates in stock assessments and fin clips used for genetic analysis, especially of cryptic species. As EM improves and fishers are able to discard more managed species at sea, the number of specimens collected will also increase and continue to add value to both the observer and EM datasets that describe this fishery.

Since 2015, the WCGOP and the EM program have worked together to collect and synthesize datasets that can be used to inform management while helping fishers navigate a new world of monitoring. By leveraging the compliance monitoring for which EM systems were designed, our observer program has enhanced its data collection protocols, while continuing to provide the best available catch estimates for all species impacted by the fishery.

Applying REM to improve estimates of commercial catches – Haddock 7b-k catches by the Southwest English otter trawl mixed fishery

Tom Catchpole, Sam Elliott, Ana Ribeiro Santos, Jon Elson, Ramon Benedet, Michael Spence, Lillian Sandeman and Paul Nelson

CEFAS, UK

<u>Introduction</u>

The reformed EU Common Fisheries Policy (CFP) came into force on 1st January 2014 with a ban on discarding (so-called Landing Obligation) for certain regulated species. This discard ban is being phased in, and will cover all quota stocks in EU waters by January 2019. It is anticipated the move from a landing-based quota to a catch-quota system will motivate changes in fishing behaviour and practices, so that unwanted catches should be avoided. The CFP allows for quota adjustments (so-called uplift) to be made for those stocks under the Landing Obligation (LO), recognising fish that otherwise would have been discarded will now to be landed. These adjustments are being made based on the estimated discards of the concerned stocks, which are derived from a sample of less than 2% of all fishing operations, and then extrapolated to the fleet level. Because estimates may not be representative of true discard patterns, the fishing industry have claimed that discard data deficiencies are the highest risk in the transition to the LO, and insufficient uplift in quota could stop vessels from fishing (Catchpole *et al.*, 2017a).

Based on consultations with the fishing industry, it is considered that the haddock ICES 7.b-k stock is the most likely choke species for English southwest otter trawl fisheries under the implementation of the Landing Obligation. There is a widespread perception from the fishing industry that there is a mismatch between the quota (TAC) and catches of haddock in the Celtic Sea and Western Channel, and this is generating a high level of discards, which are thought not to be reflected in official discard estimates. The extension of the Landing Obligation to haddock 7.b-k is considered to cause a choke point, and a cessation of fishing activity, because current estimates of discard rates are not accurate. These concerns led to the initiation of a series of meetings between UK government, enforcement agents, scientists and the fishing industry which started in March 2017. At these meetings it was agreed that there was benefit in collecting additional data on catches and discards in this fishery to inform on future management options.

This presentation describes the methods that have been developed and applied to deliver an enhanced data collection programme, specifically designed to generate more reliable data on discards of haddock in the Celtic Sea English otter trawl fishery. REM systems were installed in 3 vessels, and protocols were agreed with skipper and REM analyst to record and estimate haddock landings and discards.

Results

Error! Reference source not found. shows the relationship between the REM analyst and s kipper's discards and landings estimates, respectively. Overall the retained panel shows a better correlation than the data in the discard panel. Preliminary outputs of the model have been used to predict haddock discards from skipper's estimates, based on the relationship between the REM analysts and skipper's data.

Based on the skippers' estimates, and how close these corresponded to the REM analyst estimates, haddock discard quantities for the period July to December were between 294,826 – 351,442 kg (90% CL) for the MFV Crystal Sea, 3950- 4849 kg (90% CL) for the MFV Swiftsure II, and 1398 – 1400 kg for Spirited Lady III. For both Crystal Sea and Spirited Lady, the total discards estimates from the skippers fall outside the C.I. (Figure 4). This is because we are using the REM analysts as the truth and the distribution of discards estimates from the model are significantly lower than the skipper's estimates. The modelled skippers discards showed a discard rate around 81% of the total haddock catch (76% - 80% C.I.).

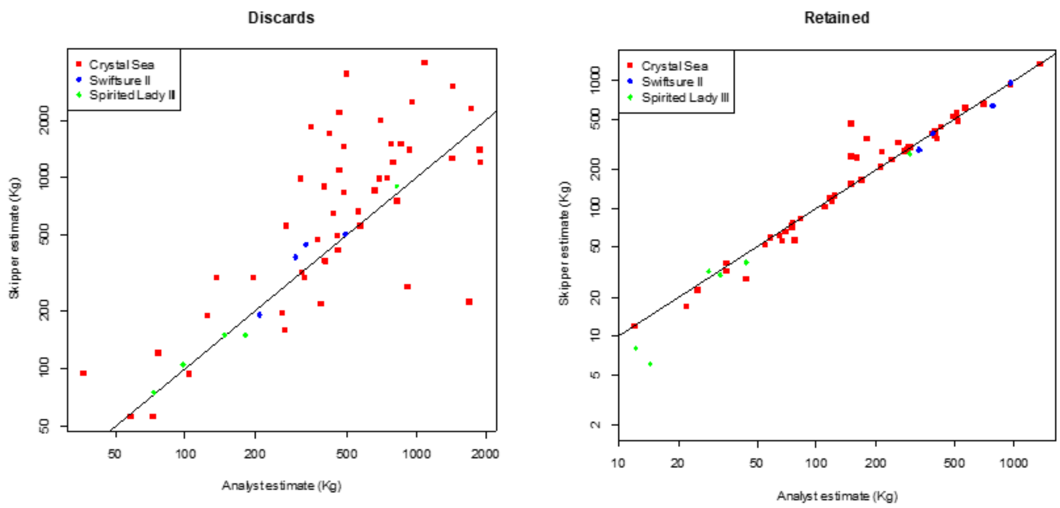


Figure 1 - Comparison of haddock discards (left) and landings (right) estimates from skippers and REM analyst.

Representativeness of the Cefas Observer programme and REM vessels

Figure 5 shows the number of trips by rectangle, made by English otter trawlers fishing in ICES 7.e,f,g,h, between July and December 2017, and the haul positions of the three REM vessels and Cefas Observer sampled trips. Most of the otter trawls fishing effort was in ICES area 7.e, off Plymouth and Lyme Bay. However, most of haddock landings are from SW edge (ICES rectangle 28E4). REM vessels operated in two distinct areas that correlated where most of the effort took place. The Cefas Observer programme sampled trips, also overlap where most of the effort of the English otter trawl fleet took place but also cover a broader area.

Comparing estimates between skippers' and Cefas Observer programme

A motivation for this work was the industry perceived difference between the discard estimates derived from the scientific observer programme and their own experiences during fishing. Here we compare between the REM and observer programme, the discard rate and the estimated total haddock discards and catch quantities generated by the English otter trawl fleet. Within the same period that the skippers' data was generated, July to December, skippers haddock discard rates were 80%, while the Observer programme were 56%. During the same period there are data from 744 more hauls from the skipper, demonstrating the benefits of the enhanced monitoring programme using REM and skipper's data. The mean discard rates from the new enhanced data collection programme are higher than the ongoing observer programme for the same period. Currently it is the observer discard rates that are applied to the official landings data to generate a total discard quantity and inform on total catches and will influence the level of uplift with the implementation of the Landing Obligation. The discard rates from the new enhanced data collection are highly influenced by the discard rates generated by one vessel.

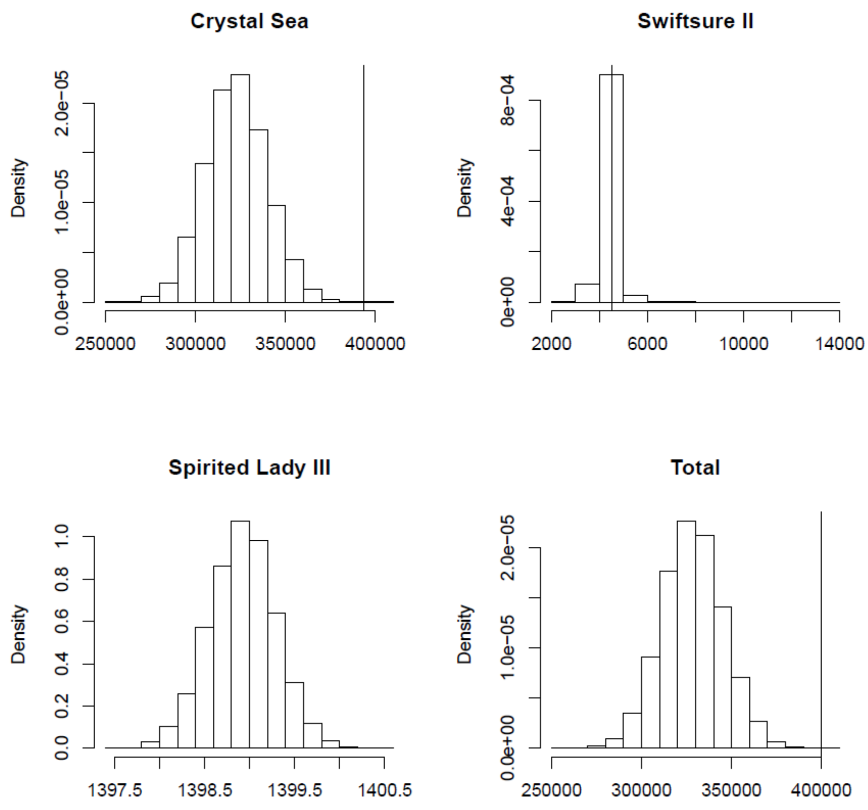
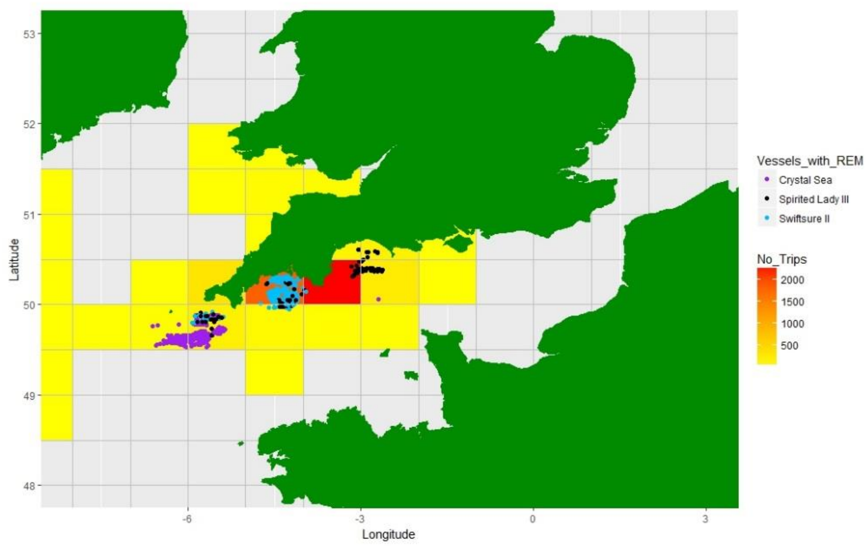


Figure 4 - Estimated discards distribution for each vessel and the total, based on the Monte Carlo simulations. Solid line is the value estimated by skipper.



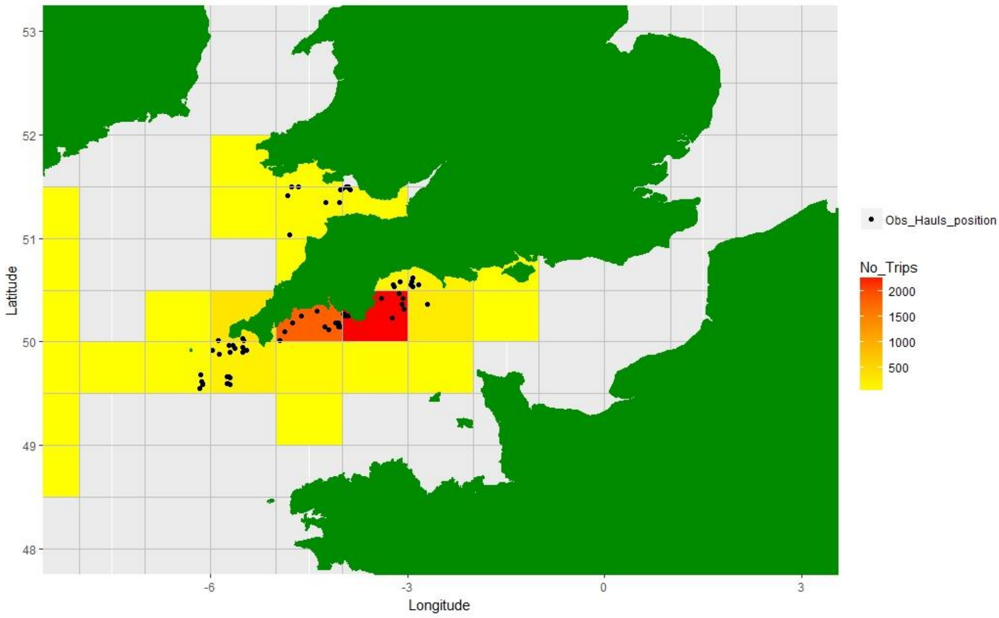


Figure 5 - Number of trips of otter trawlers by ICES rectangle, in quarters 3 and 4 (July – December), 2017 and haul locations for each REM vessel (top) and for Cefas Observer programme sampled trips (bottom).

<u>Conclusion</u>

The data from the continuous monitoring and the standard hauls from the survey are used to provide estimates of discards for these three vessels for the period of the study. The results indicate high discard rates of haddock, where 80% of the haddock total catch is being discarded. This is based on skippers' results, validated by independent analysis of Remote Electronic Monitoring data using a model which accounts for differences. A process was developed for using these derived estimates with those from the ongoing Cefas Observer programme in preparation for the 2018 ICES Assessment Working Group.

However, uncertainties in relation to the skipper and REM estimates still need to be resolved, in order to understand where the differences result from. We need to understand what the skipper bases his estimate on and consider alternatives if necessary, and whether there is a critical mass or processing rate within the field of view for the REM analyst over the conveyor beyond which the analyst estimates become unreliable. Changes to the skipper and REM analyst protocols will be reviewed and changed to improve the estimates and reduce the bias.

Open Discussion Session

A: What you have presented is very high tech/high-minded. It is difficult for developing countries with little money to follow the lead. In the future, it would be beneficial to get more contributions from Asian and African blocks.

Q: How are EM/Observer data compared and combined for use in stock assessments.

A: Much work has been done by the EM program to compare EM and observer data, particularly with quota species. EM has found that observer and EM numbers are pretty close.

Q: Bias from skippers is a concern. Are there incentives to misreport haddock?
A: Since this is a voluntary process, driven by specific segments of the industry to show that there is a problem, there is a reason to believe that bias exists, at least with some vessels. But, we should take opportunities to engage with industry when they are willing to participate. This is just a start to engage with industry.

Q: A lot of effort goes into training observers. What are the standards for training video reviewers? How are they vetted?
A: This is a relatively new process, and we have made comparisons. There are often differences in interpretation of species identification.
A: A lot of work has been done to assess what reviewers can identify, reasonably. Limitations have been identified, as opposed to observers, who can generally identify anything that comes up.
A: Reviewers are often ex-observers. There is good dialogue, regarding what's feasible, and there are lots of sources of information.
A: I like the idea of using opportunistic data. I believe it is useful and more work should be done to assess the value of this type of data.

Q: Regarding haddock, what you found from the interaction with industry, is that they have a huge problem with discards. I am curious how you communicate what you've discovered with industry and whether or not you have a strategy moving forward, for when the landing obligation begins?
A: A strategy…no. It is always difficult communicating with industry. With the landing obligation, industry is going mad. It is currently peaceful, but difficult species are coming next year. We have had several cooperative projects with industry. We push for that. We try to engage them and include them.
A: Obviously, we do need a strategy. There is a gap between EM and observer data. We see differences in all three methods. Vessels estimate to a ½ ton, so not a good resolution.
A: We need to try to get participants from these countries. Quite a few people here have expertise working in developing countries to develop observer programs. There are travel grants available to send them here and us there.
A: There is a huge industry in India and all deliver catch, so maybe focus efforts there, at the factory.

Q: Is it correct that discards of cod didn't seem to vary between the observer and non-observer vessels? What are the reasons for refusal to carry observers?
A: Regarding refusals, maybe they hate me personally. There is a randomized vessel list, and observers call all vessels on the list. Often, they give bad excuses or just don't want to participate. Regarding the comparison, I looked at vessels that refused observers and those that did not have a problem taking observers and there was no significant difference. So, it may not be that they have high discards that they are trying to hide, but that they simply don't trust the scientists/government.
A: It would be worthwhile to consider holding a special panel for developing countries at a future IFOMC, similar to the artisanal fisheries panel at past conferences.

A: Grading machines are promising. I encourage you to start taking lots of photos to aid machine learning.

Q: I am stunned by how different the estimates are for haddock discards. How are EM analysts quantifying haddock discards? How were they trained and have you asked industry to handle catch differently, to help with the process?
A: We had EM/Observer/Skipper estimates for same vessels so that they could be easily compared. Often observer estimates are lower than skipper estimates. There is bias, due to change in the sorting speed (e.g., speeds up towards the end). Observers tend to sample early.

Q: Regarding the Haddock fishery and your work with the industry. Did working directly with industry affect the insights gained; more with EM than observers?
A: Observers interact as much as EM. Cameras are voluntary and some prefer EM. Industry is keen to provide the information. Some go out of their way to show something which is not necessarily representative of what's happening.

Q: Is there any way to use observers to perform EM review?
A: We utilize observers for this. Many do both and enjoy the change of pace. The salaries are pretty competitive at this point.
A: Most observers aren't full-time observers, meaning they have other jobs. So, EM is an excellent way to fill time. We don't employ full-time 100% observers.

Q: Are you prepared to comply with landing obligation rules and do you have a plan to mitigate discards?
A: We plan to use EM and change the selectivity of nets to avoid haddock. Since 2014, and before, there have been lots of incentives to modify nets, but it is not part of our regulations. I don't care whether they comply with the landing obligation or not; we just want accurate data.
A: Everyone's scared of the landing obligation, both science and industry. There is a reasonable relationship with enforcement, and they will only use data to prosecute when absolutely necessary. The landing obligation hasn't resulted in refusals, yet, but this will become a problem soon.

Poster Presentations – Extended Abstracts

Estimating unreported bycatch and discards in Norwegian fisheries under a discards ban.

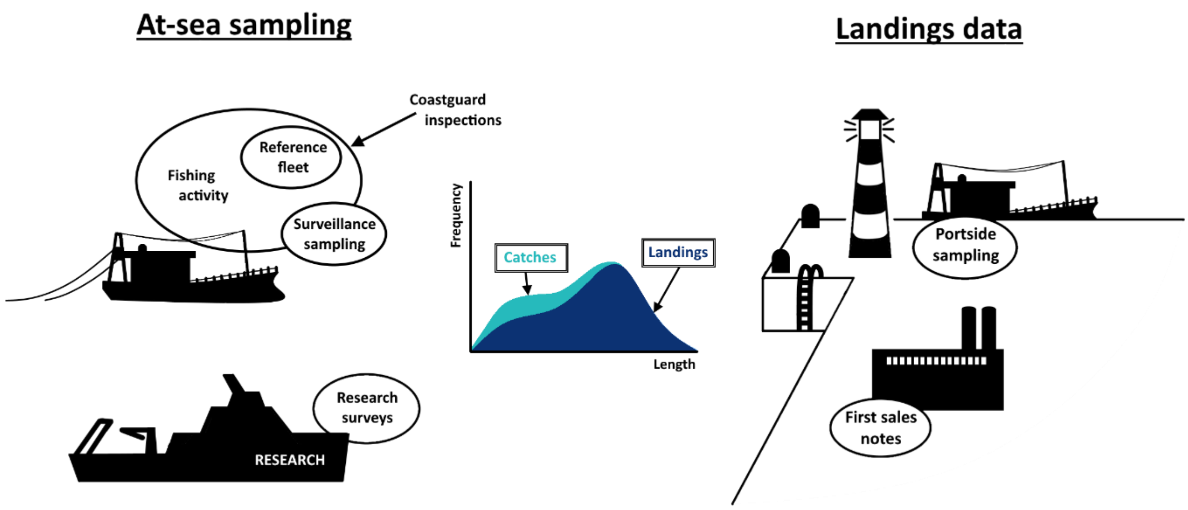
Tom Clegg, Kjell Nedreaas, Geir Blom

Institute of Marine Research, Norway

The Norwegian discards package, established in 2009, requires vessels to land and report all catches, providing the framework for a fully documented fishery. It aimed to broaden fisheries management away from just the target species to accounting for all catches in the fishery, whilst shifting the focus from “landings” to “total catches”. However, there are still many sources of unreported catches, such as misreporting, insufficient detail in reported catches and continued discarding.

An ecosystem approach to fisheries management requires knowledge of the total extraction from a fishery, which therefore includes a reliable estimation of these unreported catches. Stock assessments can be vulnerable to biases introduced by unreported catches, which could produce misleading estimations of fishing mortality, stock status and management advice. Therefore, it is important to quantify the extent and variability of unreported catches to include them in stock assessment models. These estimates must come from data which are reliable, readily available and in the correct format for inclusion in stock assessments.

In Norway, sampling data can come from numerous sources, including inspections by the Coastguard, surveillance sampling by the Norwegian Fisheries Directorate, and dockside sampling by the Institute of Marine Research. There is also potential to use data from the Norwegian Reference Fleet, a group of active commercial vessels spread throughout Norwegian waters that are paid to supply detailed information from each trip, including their discards. The data sources available to this study are summarised in the figure below.



Each fishery can be divided into multiple strata – a combination of gear, area and season. Key areas of the fishery will be identified and a vessel list obtained using catch logbooks and vessel monitoring data. For each stratum, catch data from on-board sampling of individual hauls will be paired with either official landings statistics, production reports or logbooks to estimate the unreported catches. Under a discards ban situation, all catches must be landed. Therefore, any differences in quantities or size compositions between catches and landings can be assumed to be a result of unreported catches. In data-deficient fisheries, auxiliary data from monitoring inspections and scientific research surveys can supplement biological information.

The data will be analysed using a modelling approach to quantify unreported catches for the fishery, whilst identifying the driving factors behind discarding, including spatio-temporal trends. An increased understanding will also contribute evidence to sustainability certifications and help to evaluate the effects of unreported removals on the ecosystem, such as impacts on food webs or ecosystem functioning.

The following steps will help fill knowledge gaps and inform an estimation of unreported bycatch and discards in Norwegian fisheries:

1) Validate the representativeness of sampled data for estimations.
2) Identify the best practise procedure for raising fisheries-dependent catch sampling data in selected Norwegian fisheries.
3) Quantify bycatch and discards in selected fisheries, and explore the spatio-temporal trends.
4) Estimate the contribution of unreported bycatch and discards to total fishing mortality.
5) Evaluate the possible effects that unreported bycatch and discards may have on ecosystems.

Albatross Bycatch in Alaskan Longline Fisheries: Modeling rates to inform trends

Kimberly S. Dietrich[1], Edward F. Melvin[1], Robert Suryan[2,3] and Shannon M. Fitzgerald[4]

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Abstract Although the incidental mortality (bycatch) of seabirds and other long-lived species ranks among the most critical conservation issues in world fisheries, case studies documenting significant reductions in the mortality of these low productivity species in a fishery are rare. Our analysis of 23 years of fisheries observer data spans pre- and post-adoption of streamer lines (STLS) – a seabird bycatch prevention measure developed in an intensive collaborative research program with industry. Following adoption of STLS, at first voluntarily and then by regulation, seabird bycatch per unit effort (BPUE) was reduced by 77% to 90%. Despite this clear success, our models also showed a significant increasing trend in albatross BPUE in the sablefish fishery since STLS were adopted. Our finding that a small number of vessels accounted for a disproportionate number of albatross captures in the observed bycatch may partially explain these trends. Although night setting yielded significant (74% to 97%) reductions in most seabird BPUE and significant increases (7% to 11%) in target fish catch per unit effort compared to daytime setting, nighttime setting increased the BPUE of northern fulmar (Fulmarus glacialis) by 40%. Our findings suggest that best practices to prevent seabird mortalities in longline fisheries vary by seabird species assemblage and fishery. This case study informs global fisheries bycatch reduction efforts by illustrating that successful conservation requires: fishery specific solutions, strong industry support, constant vigilance in analysis and reporting of observer data, as well as ongoing outreach to fleets, especially to those vessels with anomalously high BPUE.

Introduction
Seabird bycatch is an important conservation concern in world fisheries, yet case studies documenting significant reductions in mortality are rare. The North Pacific Observer

Program (NPOP) has collected data on seabird bycatch in Alaskan fisheries since 1993, spanning pre and post fleet-wide adoption of streamer line (STLS). Initial seabird bycatch estimates for Alaska were extrapolated from relatively few direct observations on vessels to the entire fleet based on total catch, often including assumptions that increase variability and uncertainty. To increase precision in bycatch estimates and detect change over time, we calculated seabird bycatch per unit effort (BPUE) from observed sets in Alaska longline fisheries before and after the adoption of STLS and modeled BPUE trends post-adoption of STLS in the sablefish (*Anoplopoma fimbria*) and Pacific cod (*Gadus macrocephalus*) fisheries.

Methods

We analyzed NPOP 23 years (1993-2015) catch and effort data by set. Numbers of sampled hooks in a given set varied by more than two orders of magnitude, therefore, we used weighted means and standard errors with sampled hooks as the weighting factor. Seabird bycatch data is both zero-inflated and over-dispersed. Consequently, we used zero-inflated negative binomial (ZINB) models. Because the majority of albatrosses were taken in the sablefish fishery (> 85%), we modeled fishery–seabird groupings separately. Here, we only present the post-STLS adoption model to explore trends of and variables affecting seabird bycatch post-STLS adoption in 2002-2015.

Results

Observers reported 45,337 seabirds caught during over a quarter million sets. The BPUE all seabirds dropped precipitously (80% decrease for albatrosses) after the voluntary adoption of STLS (Table 1). Albatross BPUE was highest in the sablefish fishery. Season and Area were included in both the count and binomial components of our final post-STLS adoption model while year – a continuous variable – was significant in only the count component, and time-of-day was significant in the binomial component of the model. No significant first order interactions were detected. Although predicted mean albatross BPUE decreased from the pre adoption era, they steadily and significantly increased over the 14 years post STLS adoption (Fig. 1) and across the four geographic areas. Albatross BPUE was 80% lower when hooks were deployed at night compared to daylight hours (Table 2) whereas fulmar CPUE was significantly higher at night. Of the vessels monitored by the NPOP from 2013 to 2015 that targeted sablefish (178) and cod (98), roughly a third caught seabirds. In the sablefish fishery three vessels accounted for almost half (43%) of the 94 albatrosses observed caught.

Conclusions

Alaska longline fisheries represent one of the few cases where sharp reductions in seabird bycatch demonstrated in research translated into sharp reductions (77-90%) in the reality of an active commercial fishery. Approximately 9,400 albatrosses and 141,000 non-albatrosses were saved in the post-STLS era. After STLS adoption, the magnitude and trends in seabird BPUE varied by target fishery and by seabird species groupings. Consequently, analysis of BPUE for Alaska fisheries are best conducted at the target fishery level in order to detect meaningful trends. Potential explanations for increasing trends in albatross bycatch include complacency with few bycatch mortalities of endangered short-tailed albatrosses in the post adoption era, changes in the distribution of fishing effort, reduced natural prey for seabirds, or seabirds habituating to streamer lines.

Although night setting is an accepted best practice to prevent seabird bycatch in longline fisheries globally, few studies consider the impact of night setting on the CPUE of target fishes. We demonstrated that night setting reduced BPUE of most seabird species while also increasing CPUE of target fish species. Higher BPUE of fulmars at night versus day, however, may be unique to northern hemisphere fisheries and supports the contention that best practice recommendations should be area and fishery specific.

We posit that the greatest potential to further reduce albatross bycatch in Alaska longline fisheries is targeted outreach to vessels with high BPUE. Routine analysis and reporting of observed seabird BPUE by target fishery is central to detecting trends and reducing or maintaining reductions in seabird bycatch.

Acknowledgements: We thank the NPOP for providing the data used in this analysis; the enormous contribution of the hundreds of individual observers who collected these data; T. Cardoso for providing modeling advice; A. Gladics for assistance with data management; The David and Lucile Packard Foundation and The National Fish and Wildlife Foundation for funding this work; and Washington Sea Grant for supporting EFM. The findings and conclusions in the paper are those of the authors and do not necessarily represent the views of the NOAA Fisheries.

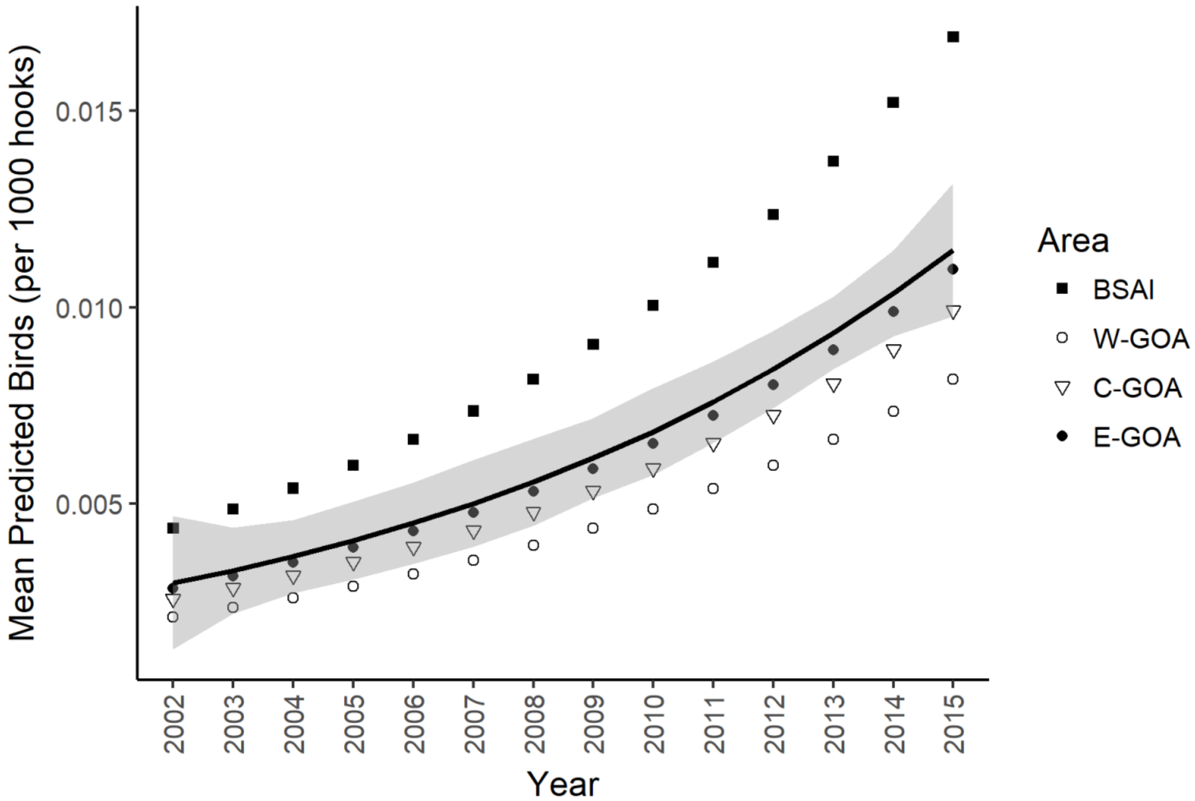


Figure 1. Mean annual predicted bycatch rate overall (dark line) with 95% confidence interval (grey shape) and by major management region for albatrosses in the sablefish fishery in the post streamer line adoption era (2002 to 2015).

Table 1. Summary of longline effort and seabird bycatch by species (bird numbers, weighted mean bycatch per unit effort [BPUE; birds/1,000 hooks] and weighted standard error, SEM) in the observer sample before (1993 to 2001) and after (2002 to 2015) adoption of streamer lines in Alaska longline fisheries.

	Pre-Adoption		Post-Adoption		
	Number	BPUE (SEM)	Number	BPUE (SEM)	% Decrease
Hooks sampled (x 1,000)	370,458	–	703,120	–	–
Sets sampled	98,700	–	164,779	–	–
Total Albatross	1,959	0.0053 (0.0002)	392	0.0006 (0.0000)	80.0%
Total Non-Albatross	30,029	0.081 (0.0016)	12,997	0.018 (0.0004)	77.8%

Table 2. Mean (simple) bycatch rate (birds/1,000 hooks) and SE by seabird species or species groupings for all target species combined and catch rate (kg/1,000 hooks) of target and non-target fishes in the sablefish and cod longline fisheries for sets made during the day and at night in the post streamer adoption era (2002 to 2015).

	Day		Night		Mann-Whitney U (millions)	p	% Change
	Mean	SE	Mean	SE			
Seabird Bycatch							
All Albatrosses	0.003	0.0002	0.000	0.0001	3380	0.000	-91.1%
All Non-Albatrosses	0.023	0.0006	0.017	0.0007	3410	0.000	-26.7%
Fish Catch							
Sablefish Target	273.3	1.9	292.7	3.2	42.9	0.000	6.7%
Sablefish Non-target	321.7	2.8	337.5	4.5	43.4	0.000	4.7%
Cod Target	464.4	1.2	519.2	1.1	1840	0.000	10.6%
Cod Non-target	144.2	0.8	161.0	0.5	1790	0.000	16.6%

Two case studies of applying decision tree models to improving observer data quality: observer retention and species identification

Debra Duarte

Northeast Fisheries Science Center, Fisheries Sampling Branch

Abstract

Decision trees are powerful machine learning tools that are used for predictive analytics in many domains. Here, I present two examples of its use on data from the Northeast U.S. Fisheries Sampling Branch (FSB).

The first is the challenge of retaining experienced, high quality observers. High turnover can lead to increasing training and support costs, loss of data quality, more time spent on quality control, and complaints from the fishing industry about inexperienced observers. Survey results can provide broad qualitative trends, but cannot identify which individual observers are most likely to quit observing. By combining different factors, the decision tree prediction algorithm gives a probability of how likely an observer is to remain working over a specified time period. These factors can include data prior to becoming an observer (such as degree(s) earned and GPA), performance during training classes (such as grades on various assignments and attitude), and metrics about their field experience (such as number and types of trips taken, interaction with staff, disciplinary actions, safety incidents, and much more). The program manager(s) can use these scores to decide how to prioritize staff time and resources for the highest possible retention.

The second example is the validation of species identification records. FSB requires that observers submit photos or samples of a subset of species encountered to confirm their identification accuracy. But there are still a large number of records that remain unconfirmed either because photos/samples were not taken or the photo/sample quality was insufficient to provide a positive ID. Human experts may be able to pick out errors by visual inspection of the data, but that can be a daunting task. Instead, a decision tree can be trained on the validated species records, using factors such as season, location, depth, and fishery. The trained model can then be applied to the unconfirmed records; records with a high probability of inaccuracy are flagged for review, making more efficient use of the experts' time. The corrected records can then be included in the training set for future iterations, further improving the algorithm's accuracy.

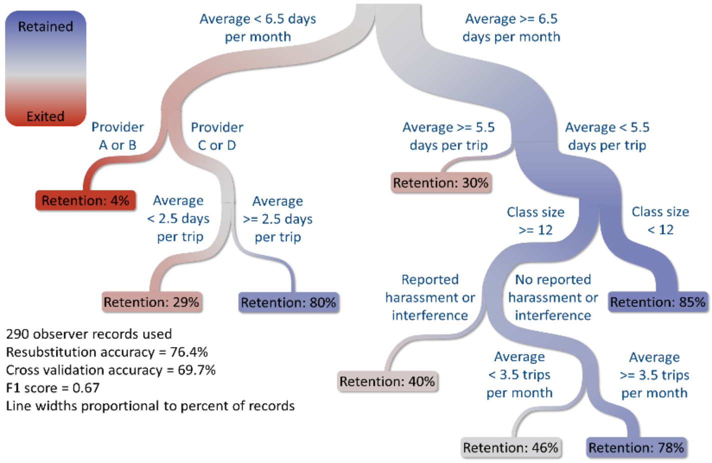
These two examples show how decision trees can be used to identify trends that might not otherwise be apparent and make allocation of human resources more efficient. Because of their broad applicability and relative ease of use (using open source software such as R), machine learning tool can become strong assets to any observer program.

<u>The Models</u>

Models were built in R using packages *rpart* and *rpart.plot*. The most time consuming part of building a model is determining which factors should be included. For both models, I first queried the observer program data for the dozens of parameters associated with each observation, then did a preliminary cut based on my expertise and judgement about what could possibly have an influence and what was very unlikely not to. Next I had to decide on an output variable to model. Models can be either regression (numeric continuous output) or classification (nominal or ordinal output). The more factors and possible output classes included, the slower the model runs. Data was split into two random sets, with approximately 75% of the records being used as the training set and 25% as the validation set across which the trained model was tested. This prevents overfitting to the specific training data. Models have been simplified for this presentation but can be more complex.

Observer Retention

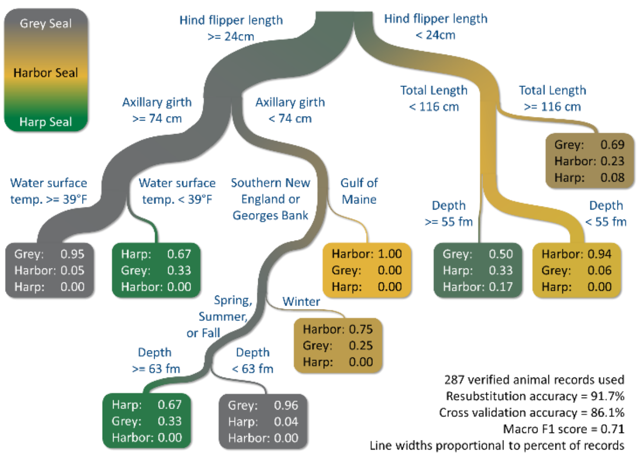
A large amount of information is collected about each observer that is trained and certified by the Fisheries Sampling Branch. The hardest challenge was choosing a timeframe of interest. Retention factors for a new observer would certainly be different than someone with 10 years experience. Various data were gathered for each observer that was trained between 2012 and 2016, including activity level (e.g., number of trips and seadays per month, types of trips, locations), incidents (e.g., harassment reports, number of in-house debriefings), and training history (e.g., number of trainings attended, class size, and final grade). The output metric is the probability of retention after 1 year from initial date of hire.



The initial split between observers who remain with the program and those who exit is the number of seadays they accomplish, which is directly related to their pay. This work can be expanded by looking at different classifications of exits (e.g., leaving to pursue graduate school, promotion to in-house staff, or decertification) or by predicting length of employment as a continuous variable. Similar work (not shown) has been done to predict training grade based on resume details, showing that previous observing experience, minimum biology college credits, and sea experience were significant predictors of successfully passing the training course.

Species Identification

Seals were chosen for this demonstration because there are only 3 species commonly encountered in the Northwestern Atlantic. Photographs are required whenever possible, so most identifications are verified. Input variables included information about the animal itself (body measurements and ratios), the time and location of the capture, and characteristics of the fishing gear (e.g., gear type, various gear dimensions, haul or soak duration). The outputs are the relative likelihood of each of the 3 common species.



Animals whose identification did not match predicted were investigated further. In some examples, there had been ambiguity in the original ID, typically because of poor photographs or very damaged or degraded specimens. The model was run against the body of 670 unverified animals (e.g., no pictures submitted for verification) with 71% match rate. Work on other species groups is ongoing but slow, due to the increased number of possible classes (e.g., 95 species of birds, 98 species of sharks) and fewer verified records per species.

Conclusions

Machine learning models such as decision trees can be applied to observer data to improve data quality and retention. Decisions trees do not require normalization of data nor assumptions about data distribution (e.g., normality). Decision trees are particularly well-suited to identifying trends because of the visual, hierarchical output. Specific rules can be developed and applied to data in real time. For observers, this gives the earliest possible warning signs that an individual may need additional intervention. For species ID, this prevents a misidentified animal from being added to the observer database, which can strongly influence bycatch analyses, especially for rare species. Machine learning models can be subject to overfitting to a training set. Splitting data into training and validation sets can prevent overfitting.

It is important to be aware that the outputs are statistical probabilities with some degree of error. Therefore when analyzing, say, a mismatch between identified and predicted species ID, the user must keep in mind that there is a possibility that the record may not be erroneous. Similarly, we cannot say with 100% certainty that an observer with particular characteristics definitely will or will not stay with the program, only that certain patterns are very likely associated with higher or lower retention.

Abstracts of presentations that did not provide Extended Abstracts

Use of control data to estimate discard

Marie Storr-Paulsen, Kirsten Birch Håkansson

DTU Aqua - Denmark

Since 2015 the European control agency (EFCA) has initiated member states in EU to conduct “last haul” surveys with the national control agencies. A last haul is conductedon board a commercial vessel by the inspectors from the control agency, being present on the vessels when the catch is towed on board. The inspectors are measuring the total catch (on selected species), in weight and are registration the amount of fish above and below the current minimum reference size (MRS). These data sets could potentially be a large contribution to the observer programs presently conducted by most EU countries to estimate the discard levels from different fleet segments. However, the aim of the sampled data from the control agency are potential different from the collected discard data derived from the scientific observer programs and caution has to be put on the design of the sampling program. If the control agencies are using a risk based approach to target the fishing vessels in the last haul program, data can be biased, compared to a statistical random selection program targeting commercial vessels. DTU Aqua was provided access to the Danish control agency (AgriFish) data from the last haul program sampled in the time period 2015-2017. In that period AgriFish sampled 345 "last haul" on Danish vessels – and compared to that DTU Aqua sampled 582 trips at-sea with scientific observer.

This study develops guidelines on how to make best use of the "last haul" samples to strengthen national discard estimates e. g. as independent discard estimates, for validation of scientific observer data or in combination with scientific observer estimates. The guideline includes e. g. 1) analyses of potential biases in the selection of samples by looking at catch and spatial patterns, 2) analyses the estimates the samples can provide with the given sampling protocol by looking at e.g. potential high-grading in the fisheries, 3) statistical methods for comparing estimates from two sampling programs and 4) methods for combining two sampling programs. Further it discusses how the "last haul" sampling design could be altered to make the data more useful for scientific purposes.

Electronically monitoring release method as a proxy for Pacific halibut discard mortality rates in the directed Pacific halibut longline fishery

Claude L. Dykstra, Timothy Loher, Ian J. Stewart, Allan C. Hicks, Josep V. Planas

International Pacific Halibut Commission

Due to regulatory requirements, all Pacific halibut that are of sublegal size in the directed fishery cannot be retained and must be returned to the sea with minimal injury. Through the process of capture and release, Pacific halibut incur a range of injuries and are subjected to a variety of factors that will affect their survival potential after release. Accurate understanding of the types and relative levels of injuries and stresses that Pacific halibut are exposed to during the discarding process in relation to the biological characteristics of the fish can be instrumental in helping better estimate the probability of mortality resulting from the discarding process. Discard mortality rates (DMRs; a measurement of potential mortality) in the Pacific halibut longline fishery are currently estimated from injury or vitality data obtained on observed trips. The small vessel (<57') longline fleet in Alaska is currently developing electronic monitoring (EM) capabilities, but determining vitality codes requires handling of the animal (which includes looking at both sides of the fish, testing muscle tone and opercular responses), which is something that cannot be achieved with cameras. EM provides information on Pacific halibut hook release techniques (careful shake, gangion cut, hook stripper) for close to 95% of events, however the suite of injuries incurred by each hook release technique is unknown. In the fall of 2017, we conducted a field study to begin developing an injury profile for different hook release techniques with associated physiological condition measures, which could then be used to calculate DMRs on vessels carrying EM systems rather than observers. Physiological parameters collected included information on condition status at capture (round weight, fat reserves) and post-handling stress levels (blood stress hormones). Additionally, we tagged and released 79 Pacific halibut with accelerometer pop-up archival transmitting tags to assess near term (96 days) survival, and 1,048 fish with wire tags to investigate longer term survival. The results of this study will be used to further refine the estimation of DMRs by each hook release category. Preliminary results will be presented.

Using Benford's Law to evaluate observer data quality

Chad Demarest, Amy Martins

NOAA Fisheries Northeast Fisheries Science Center

Benford's Law postulates a predictable distribution of first and second digits in many naturally occurring numerical data. The law was first proposed by Simon Newcomb in 1881, after he noticed that in books of logarithms, pages in the first half of the book corresponding

to logarithms beginning with lower numbers (1, 2, 3, etc.), were more heavily used than those in the second half of the book. He proposed that the probability that first digit in a conforming data set will be equal to n is the log (base 10) of 1 + 1/n. The application of this insight has been verified and applied in fraud detection and accounting for many decades and has been used extensively in criminal and civil courts to demonstrate the presence of manipulated data. Conforming data typically span multiple orders of magnitude, are not truncated and are right skewed. The distribution of first and second digits in a conforming dataset may provide critical insights into the process used to generate data.

We propose a method for applying Benford's Law in screening observer data for quality. Observer data in the Northeast US are used to monitor and estimate catch on commercial fishing trips, make decisions on how to manage fisheries sustainably, and to assess impacts on protected species and fishing communities. Observer coverage is a mandatory requirement of fishing permits and data are collected by trained biologists, certified by the National Marine Fisheries Service, and employed by an approved Observer Service Provider. Data are vetted through a rigorous audit process before being provided to authorized end-users. Using Benford's Law may augment this process.

In addition to data screening, Benford's Law is useful in understanding when data generated from different processes, such as actual and estimated weights, should be considered functionally equivalent. We find that certain data collection techniques may provide more robust and reliable data, while others may provide data that are not equivalent.

Approaches to characterizing uncertainty for fishery-level total bycatch estimates

Yong-Woo Lee, Lee Benaka, John Foster

NOAA-Fisheries, Division of Science and Technology

Fisheries with non-selective gears, such as bottom trawl fisheries, can produce bycatch consisting of hundreds of species in a given time period. Bycatch of individual species is commonly estimated with a ratio estimation approach based on observer-collected sample data. Fishery managers and/or conservation groups may have an interest in producing an estimate of total bycatch across all species for a particular fishery in order to prioritize conservation actions or support sustainability claims. Due to the varying levels of spatial and temporal coverage provided by fishery observers, bycatch data often are sampled and estimated by individual species with a stratification scheme. As long as bycatch estimates for the individual species are unbiased, a simple summation of estimates across all species should return an unbiased estimate of total bycatch. However, it is unclear how to measure the uncertainty around the estimate of total bycatch across all species. Coefficient of variation (CV), defined as the division of standard error of the estimate by its own point estimate, is often used as an uncertainty measurement in bycatch estimation. Using a resampling strategy, this presentation evaluates two approaches for the CV estimation of total bycatch: (1) summation of variances and (2) simple averaging of the CVs available from the individual species estimates. Resampling simulations were performed based on 100% observer sampled bycatch data from the U.S. West Coast groundfish Catch Shares bottom trawl fishery in 2015. The subsampling rate was 25%, and the resampling iterations were 2,000. Results indicated that the approach of averaging of individual CVs would produce a biased high CV estimate, while the summation of variances approach would produce a biased low CV estimate for the total bycatch. The cause of high bias in the simple averaging approach is due to the lack of a mechanism to account for differences in the bycatch magnitudes among the species. The reason for low bias in the variance summation approach is due to the large number of non-negligible violations of the independence assumptions among the species in bycatch patterns. This presentation concludes that a bootstrap approach would be a better choice to estimate CV for the total bycatch estimated as the summation of all individual bycatch across species in a large fishery.

Session 5. Assessing bias from monitoring programs

Leader: Jørgen Dalskov

Many countries run at-sea monitoring programs where scientific observers go on board commercial fishing vessels but only cover a subset of the fleet. The monitored vessels should be representative of comparable fleet segments, but this is not always the case - especially in fisheries where the act of discarding is illegal. This session focused on monitoring bias in at-sea monitoring programs and assessed whether potential biases can be reduced or eliminated.

Oral Presentations - Extended Abstracts

Are self-report fishing log-books a solution for measuring catch, bycatch and discards?: The case of crustacean demersal fishery in Chile.

Marcelo San Martín, J.C. Saavedra-Nievas, José López, Victoria Escobar, Catalina Román, Claudio Bernal

Fisheries Development Institute, Chile

Introduction

The catch quantification in world fisheries is frequently established through landing reports. However, this information only provides a partial view of the total catch, and may underestimate the actual levels of fishing mortalities, as well as bycatch and discards. An option to obtain more reliable or accurate information on total catch is through monitoring programs by scientific observer on board, nevertheless its implementation is frequently expensive and complex, limiting, among other aspects, the sampling coverage. Thus, there is a need to have alternative sources of information that allows an increased level of coverage, context in which fishing self-report logs by fishermen have been an alternative discussed. However, its contribution respect to catch and bycatch quantification it is not clear. This work evaluates the bias and utility of information reported by Captains trough self-report log-books as source of information to measure total catch, bycatch and discards in the Chilean shrimp (*Heterocarpus reedi*) bottom trawler fishery.

Objective

The aim of this work was to evaluate the bias of the information reported by Captains through self report log-books on total catch, bycatch and discards for Chilean shrimp trawler fishery compared with the information provided by scientific observers as well as the convenience of using the fishermen´s information for management.

Methodology

This study was developed during a discard monitoring program implemented in crustacean fishery (shrimp, red squab lobster and yellow squab lobster) between 2013 and 2016, in

Central Chilean Coast. To evaluate bias and the convenience of using the information on total catch, discard and bycatch provided by the fishing industry, captain´s logbooks were contrasted with the information reported by scientific observers on board. To obtain information from fishermen, species identification guides and self-report log books were given to captains for each vessel. For a same trip the information provided by captains was compared with those from scientific observers. A Lin test was applicated to evaluate the concordance between both sources of information, through package DevsTools (ccc) for R Software. For the shrimp fishery, the level of compliance with self-report logs was also determinated, this with regard to the total trips of the fleet. In addition, the number of species, mean catch and discards quantification by haul reported by both sources were compared.

Results

The level of compliance with self-report logs in shrimp fishery reached an average of 41% in the period analyzed. A total of 24, 118, 113 and 31 hauls for each year were used to evaluate the differences in number of species, total catches and discards reported, as well as the level of concordance for both sources of information. A low inter-annual variation in the number of species reported by both sources was observed. However, in the entire period, higher numbers were declared by observers, with a mean of 11 species versus 4 species reported by captains in log-books. In general, higher mean catches per haul were also reported by observers, especially during 2014. Thus, the main sources of differences were explained by the higher discard levels reported by observers, around of 65% 2014 and 2015, and 125% to 2016 (Figure 1).

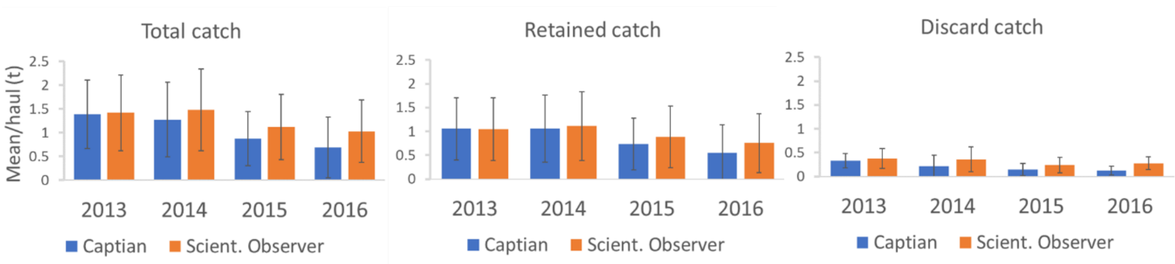


Figure 1. Total catch, retained catch and discards reported by captains and scientific observer between 2013 and 2016.

The evaluation of the reports for target species showed differences in the amount of catch retained declared by captains and observers, specially in 2015, however the difference regarding discards was low or null (Figure 2). In the case of Chilean hake (*Merluccius gayi*), one of the main species of accompanying fauna incidentally captured by the crustacean fishery, it was not reported by captains, however the observers reported retained catch for this species (Figure 2). Nonetheless, important differences were observed in the report of discards for Pacific hake discard, where the captains generally do not report discards of this species (Figure 2).

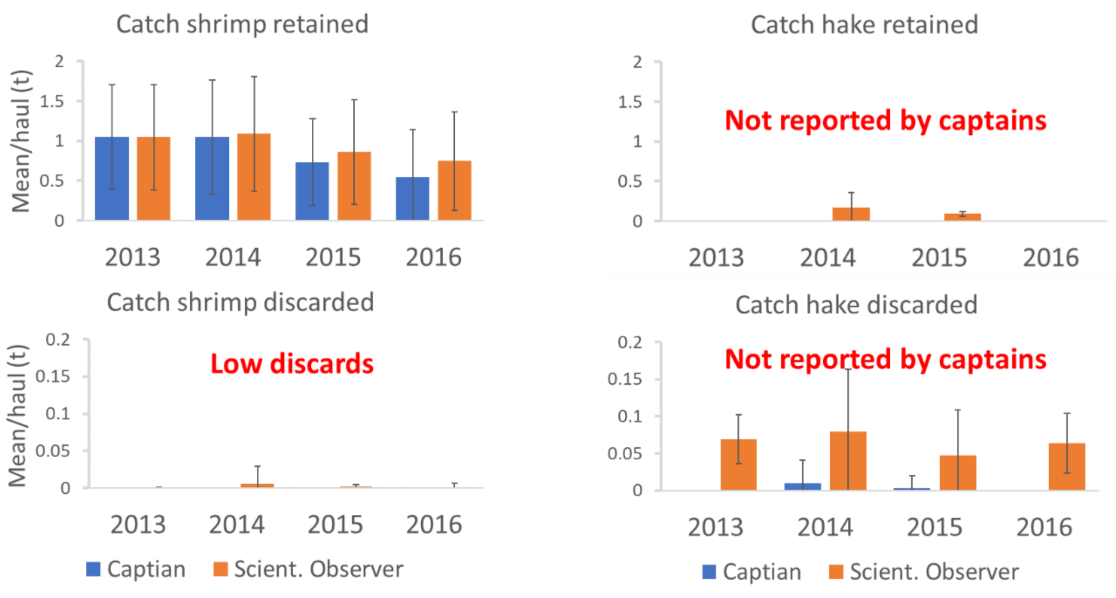
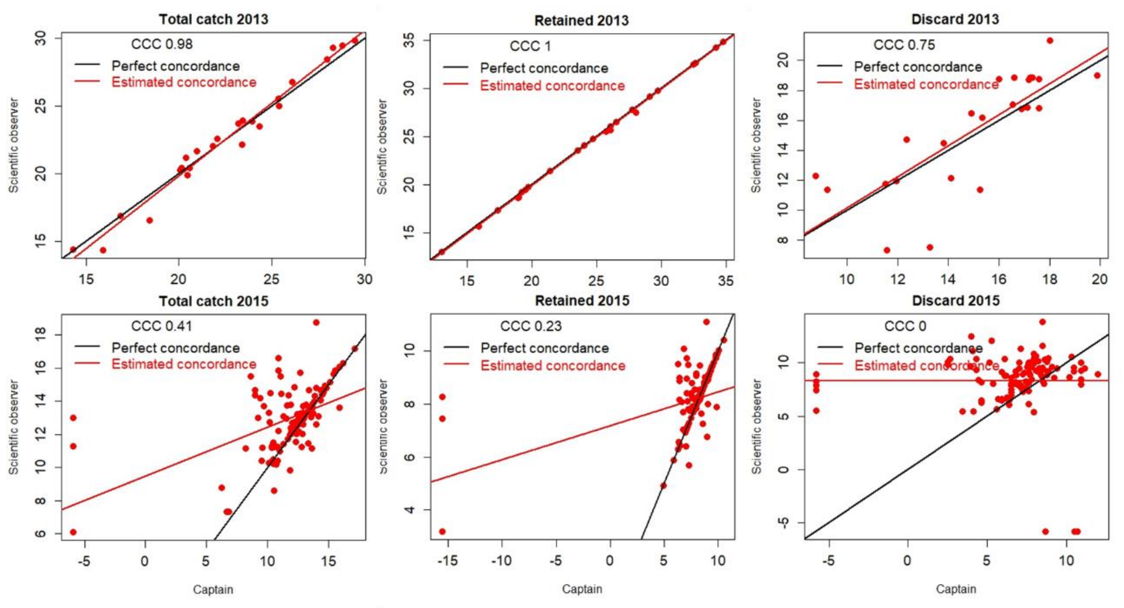


Figure 2. Retained and discarded catches of shrimp and Pacific hake reported by captains and scientific observer between 2013 and 2016.

The evaluation of the concordance between information reported by captains and scientific observers, through Lin test, established the difference in the amount of catch reported from both sources information for all years monitored, except for 2013. The figure 3 show the concordance fixed to year 2013 and the not concordance by the 2015 as an example to results observed in the other years.



Discussion

The lower number of species reported by captains could be the result of the limited capacity or training of captains to recognize or identify species. However, the differences in the amount of catches reported by both sources of information were evident, especially regarding to discards of Chilean hake. Regulations, sanctions, cultural, social aspects and mainly quota restrictions of some bycatch species such as Chilean hake, could be explaining the results observed in this work. Although self-report logs may help to increase the coverage of information, the data provided by fishermen are referential and must be taken with some restriction if used for management. Until not generating conditions that allows a trustworthy declaration on total catch, bycatch and discards by captains, the self-report logs in no case can be used for taking administrative measures or controling quotas consumption in the fisheries analyzed. Likewise, education and confidence between sectors must be improved to achieve the goals proposed.

Assessing representativeness and bias in Norwegian commercial catch sampling programs conducted in collaboration with the industry.

Edvin Fuglebakk, Håkon Otterå, Tom Clegg, Gjert Dingsør, and Jon Helge Vølstad

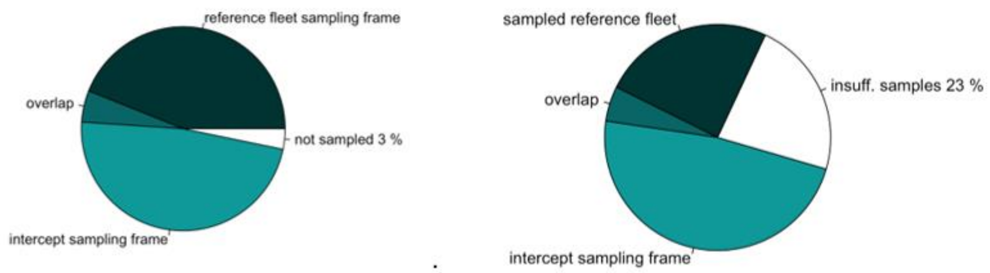
Institute of Marine Research, Norway

<u>Sampling programs</u>

Institute of Marine Research (IMR), Norway, obtains data on catch composition and biological samples from commercial catches in collaboration with the industry. These data are used for estimating by-catch, mean weight, length-, age-, and sex-composition, and maturity stage of fish for selected species. We primarily assess potential bias in catch-composition due to vessel-selection in fisheries-dependent sampling programs. The Norwegian Reference Fleet (RF) is a small group of fishing vessels that are contracted by IMR for 4-6 years to provide detailed information about their fishing activity and composition of catches systematically during the year through trained self-sampling. The RF vessels cannot be randomly selected since the law mandates an open bidding process, where the criteria for awarding contracts aim to ensure that the selected vessels are representative for segments of the fleet. IMR also runs an intercept-sampling program to collect samples from commercial catches, using a contracted vessel to visit ports up and down the coast north of 64 °N annually every quarter. Before each port-visit, IMR staff contact a gear-stratified semi-random sample of commercial fishing vessels that are expected to land their catch at the port to ensure that their catches be brought ashore as roundfish. IMR staff sample fish from each landed catch as it is sold first-hand, and then return the gutted fish to the buyer for processing. For practical and funding reasons, trips cannot be selected from all combinations of statistical areas, seasons and gears. We employed several analytical methods and tools to assess the presence and magnitude of bias. We compared data from trip reports, logbooks, and dealer landing reports from the RF and the Intercept Sampling Program with census data for the general fleet. To assess effect size for the sampling bias we quantify it conflated with other error-sources by estimating parameters registered in logbooks and sales notes, such as total weight of catches or landings, and averages of spatial variables, temporal variables, and fishing depth. We have developed quality indicators that have general applicability, and present an example of analysis using 2016 data for cod (*Gadus morhua*) - the primary target species for the RF and Intercept catch sampling programs.

Estimation

Clustered catch samples from vessel landings by trip within site-days (port-days) are stratified by gear3 and season4 (High-season and Low-season) in the analysis. RF-samples are analysed as clustered primarily by area5 and quarter, and secondarily by vessels stratified by gear6. For the intercept sampling, the clustering is a result of the survey sampling design, while the clustering of RF-samples is done post-hoc to compensate for the unbalanced sampling of catches within combinations of area, quarter, and gear due to a small sample of vessels. For purposes of isolating concerns, we have in this work estimated parameters for only the area-quarter combinations that are sampled sufficiently to provide inter-vessel variance estimates. This limits the analysis to data from area-quarter combinations for a gear where we have samples from at least two vessels. This approach sacrifices some coverage in terms of sampling frame, yet between the intercept sampling and the RF-samples, the data analysed in this work are drawn from a sampling frame that covers a total of 77% of the total mass of landed cod.



Paritioning of landed weight of cod (2016) between sampling frames (left), and between intercept sampling frame, and analysed clusters in reference fleet samples (right).

Findings

Estimates of parameters registered in logbooks and sales notes based on data from the two catch sampling programs are mostly within 95% confidence intervals. For the intercept sampling, the estimates fall outside of confidence interval only a few times, which could be expected by chance. This makes it hard to establish whether the estimates are consistent with unbiased sampling, and it is in any case reassuring that the cases where the true parameter value are not covered by confidence intervals are all found in the low season and with small normalised errors. The normalised error is described in more detail in the next paragraph (‘quality indicator’). This is consistent with our prior assumption, that the intercept sampling approximates random selection, even if randomisation is not strictly enforced at all levels. For the reference fleet the impression is largely the same, except for

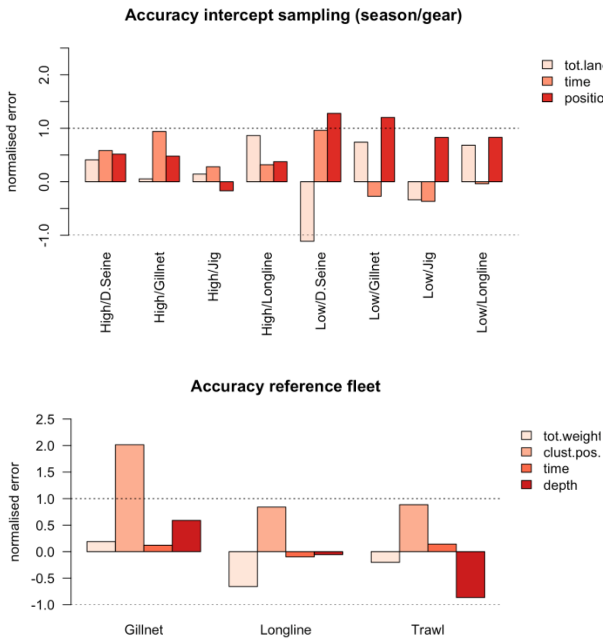
3 Strata are: Gillnet, Longline, Danish Seine and Jig

4 High season is February through May, Low-Season is June through January.

5 Area categories are polygons defined by the Norwegian directorate of fisheries.

6 Strata are: Gillnet, Longline and Trawl.

the location parameter in the Gillnet-strata, where confidence intervals for the estimate would have to be twice as large to cover the true value. Still, pragmatic informal interpretations of precision estimates holds true for these estimates as well; true values are in most cases within confidence intervals. We conclude that the non-random elements in vessel and catch selection in the reference fleet can be adjusted for by accounting for area-season-gear cluster-effects in the estimation. Hence, we argue that an interpretation of estimates of age composition and by-catch could be done with the kind of caution warranted for all non-rigorous sampling.



Normalised errors for estimates from intercept sampling (left) and reference fleet (right), based on 95% confidence intervals. For the intercept sampling, the following parameters have been estimated: tot.land, the total landed mass of cod; time, the mean day of the year of landings; position, the mean latitude of the center of area for landed catch. For the reference fleet, the following parameters have been estimated: tot.weight, the total weight of cod from logbooks, clust.pos: the mean distance of the position of catch from the center of the area; time, the mean time difference to a reference time-point in the cluster; depth, the bottom depth at the position of catch. The latter is estimated from fishing depth, which is a close approximation for this demersal fishery.

<u>Quality indicator</u>

Samples from our key sampling programs are primarily used to estimate age composition of landed catch of fish, and of by-catch in selected fisheries. The vessel- and catch-selection for these estimates are the same as for some parameters that are recorded in censuses (logbooks and sales-notes). We therefore attempt to quantify bias in these parts of the hierarchical selection by quantifying the error in estimating these census-parameters, with estimators that are formulated in such a way that direct comparison to the parameters of interest can be made. To the extent that the estimation of confidence intervals is sound, errors in estimates reflect random error and bias in sampling. For an estimate of a parameter θ (e.g. total catch or mean time of catch) where *m* is the midpoint of the confidence interval and *w* is the width of the confidence interval, we quantify this error with the measure $D=2(m-\theta)/w$. We refer to this as 'normalized error'. It essentially quantifies how much wider confidence intervals would have to be, to contain the true value of the estimated parameter. When the normalized error is between -1 and 1 the estimate falls within specified confidence intervals. For samples where the normalized error frequently falls outside this interval, the normalized error serves to quantify how far off the estimate is in terms of the precision (confidence interval) with which the estimate is otherwise presented. This precision is dictated by both the variability of the parameter of interest and properties of the sample selection, such as effective sample size. While estimates of proxy parameters cannot inform on the variability of other parameters, the properties of sample selection are the same for both the proxy parameters and the parameters of actual interest in the estimation. We therefore find this normalised error to be a useful indicator of the effect of sample bias, which is otherwise essentially unquantifiable.

What is an unobserved discard?

Anna Henry and Chad Demarest

NOAA, Northeast Fisheries Science Center

<u>Background</u>
In fisheries with less than 100 percent observer coverage, managers and scientists allocate tremendous efforts to estimate unobserved discards. Often, though, we lack the terminology to communicate precisely what we are estimating. This is particularly problematic in multispecies fisheries where regulations simultaneously mandate discarding specific species or sizes of fish and prohibit discarding of other species or sizes of fish. Such is the case in the Northeast United States groundfish fishery. Minimum size limits require discarding undersized fish; yet the fishery as a whole is managed by a quota-based system that requires landing all fish above the minimum size to determine when catch limits are met. Yearly observer coverage ranges from 11% to 32% meaning in some years up to 89% of trips are unobserved. Discard rates on observed trips are used to estimate discards on unobserved trips but, importantly, only the discards of undersized fish are estimated. We suggest the term "mandatory discards" to describe this estimate.

In any quota-based fishery there exists some incentive to discard legal sized fish, perhaps to highgrade or avoid constraints imposed by small quota allocations (Arnason 1992). This incentive is a function of the costs and benefits associated with the retention of each individual fish based largely upon differences in quota prices and expected landings prices. We suggest the term "prohibited discards" to describe such events. Implicitly, prohibited discarding is assumed not to occur on observed trips. To our knowledge no attempt has been made to estimate its magnitude on unobserved trips. The exclusive focus on estimating mandatory discards has consequences on the precision and accuracy of total discard estimates. Estimating total removals in a fishery requires careful consideration of all the ways in which unobserved discards may differ from observed discards. We develop a theoretical model comparing the costs associated with landing fish to the revenues these landings generate to estimates the stock and trip-level prohibited discard incentive.

Methods

We model the incentive to discard (*Id*) legal-sized fish (prohibited discards) as the difference between the costs associated with landing one additional unit (pound) of fish and the costs associated with retaining that unit. Costs of landing (*Cl*) include the cost of quota for that unit of fish, the cost of quota for all other stocks associated with landing an additional unit, together with sector and landing fees as well as any costs associated with on board handling such as the labor of properly gutting and icing the fish. Costs of discarding (*Cd*) include the revenue forgone when not landing one unit of fish (ex-vessel value), as well as the labor costs associated with discarding the fish and the detection probability and magnitude of sanction associated with being illegal fish discards.

The fully specified equation for the incentive for prohibited discards (*Id*) follows

The fully specified equation for the incentive for prohibited discards (*Id*) follows

$$Id_{ik} = \left[\left(Cl_i(q_i) - Cd(q_i)\right)/(pf_i * q_i)\right]_k.$$

The full cost of landing (*Cl*) is specified as

$$Cl_i(q_i)_k = \left\{pq_i * q_i + (1-\delta_k)\left[\left(\sum_{j=1}^{n} pq_j * r_j\right) * q_i\right] + Cll(q_i) + sf * q_i + lf * q_i\right\}_k$$

where r is the discard rate, as

$$r_j = disc_j/q_k.$$

The full cost of discarding (*Cd*) is specified as

$$Cd_i(q_i)_k = [pf_i * q_i + Cdl(q_i) + p(d) * s]_k$$

where i=stock, k=trip, j=stocks in broad stock areas that overlap stock i, pq = quota price, q = quantity (live pounds), δ = percent of tows observed, r = discard rate, Cll = cost of labour of landing, sf = sector fees, lf = landing fees, $disc$ = quantity of discards, qk= total trip landings (allocated groundfish stocks + non-allocated groundfish stocks + non groundfish stocks), pf = ex-vessel price, Cdl = cost of labor of discarding, $p(d)$ = probability of detection, and s = sanction associated with getting caught.

Incentives are estimated separately for each allocated groundfish stock and each groundfish trip over fishing years 2007-2017. Discard ratios are back calculated by stock and trip using the year end imputed rate.

Quota prices are estimated with a robust regression model using methods described in Murphy et al 2015. For fishing years 2011-2016 quota prices are estimated by stock for each quarter of the fishing year using inter (between) sector and intra (within) sector trades of both fish for fish and fish for cash as reported in sector end of fishing year reports. Prices for fishing year 2010 and 2017 are estimated annually due to fewer reported trades and no information on within sector trades. The value of quota for fishing years 2007-2009 (pre sectors) is assumed to be zero.

<u>Model assumptions:</u>

The incentive for prohibited discard model assumes that

- landings are representative of underlying discard incentives (e.g. the model will not estimate discard incentives for stocks that are not reported as landed);
- landings data are representative of true catch (e.g. no species substitution or other misreporting);
- modeled quarterly inter- and intra-sector quota prices adequately capture the quota cost faced by fisherman prior to making a trip;
- quota price encapsulates the marginal value of quota, where
- the marginal value of leased quota is equal to that of allocated quota (e.g. not incorporating an "endowment" effect);
- expectations of landed fish prices are adequately captured by ex-vessel prices received on each trip.
- quota prices and ex vessel prices are representative of the marginal value of quota and landings and are unaffected by illegal discarding or misreporting, if any exists; and,
- the benefit of discarding includes the marginal value of quota for that stock and the discards associated with landing an additional unit of fish, noting that this does not explicitly include the marginal value of landing any fish accessible in the future and enabled through discarding the fish in question.
- discards are calculated using the year end imputed discard rate.

<u>Results</u>

Prohibited discard incentives change by stock and fishing year, therefore any bias in catch data resulting from illegal discarding of legal sized fish is unlikely to be consistent in either direction or magnitude over time (Figure 1). Discard incentives for many stocks increased notably with the implementation of the sector system (fishing year 2010). The percentage of trips landing at least one stock with a positive discard incentive has consistently increased since 2010. This is most true for trips landing Gulf of Maine cod, noting a particularly strong increase in discard incentives for trips in 2015.

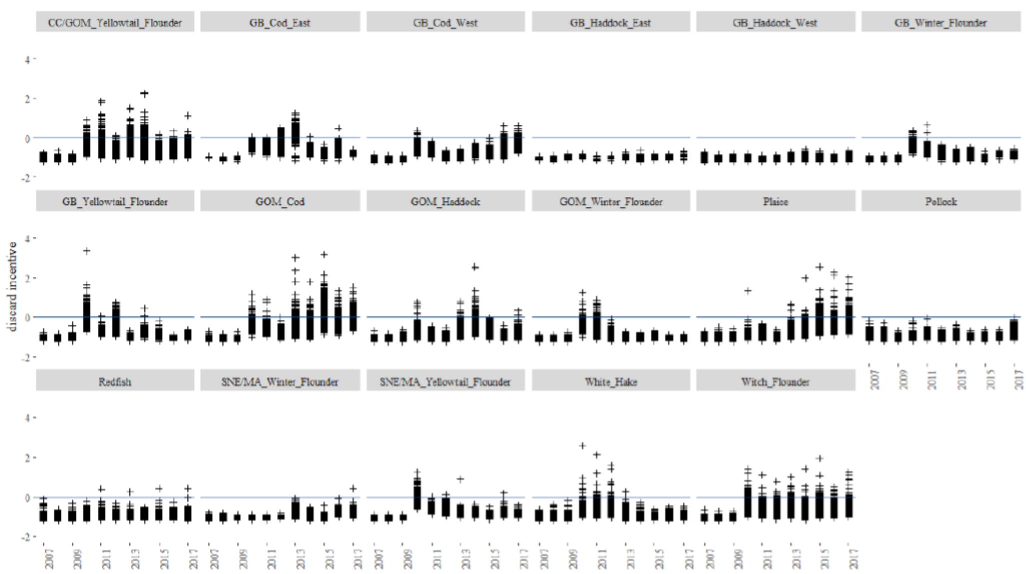


Figure 1. Estimated incentives for prohibited discards on unobserved trips fishing years 2007- 2017.

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Observer Effects in the Northeast U.S. Groundfish Fishery

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Introduction

The commercial component of the Northeast U.S. Multispecies fishery comprises 20 individual fish stocks and 2 management units7. Of these, commercial fisherman are allocated quota for 15 stocks, leaving 5 for which retention is prohibited. Fishing quota is allocated to approximately 1,000 permits and actively fished by around 200 participating commercial vessels (NEFMC 2017). The majority of the commercial fishery for groundfish (~98% of landings) is managed under a quota allocation system whereby individual vessel owners pool stock-level quota into one of 21 authorized cooperatives called “sectors”. Each cooperative retains the catch rights associated with quota pooled within it, and reserves the right to allocate that quota to individual member fisherman as per internal operating guidelines. Observers are deployed on participating vessels to estimate discarded catch for each of the 22 allocated quota stocks on each trip. Observer coverage levels vary but in general have accounted for between 15-40% of all trips taken in any given fishing year. Discards are calculated by dividing the sum of stock-level observed discards by the total amount of observed retained catch on these trips. For trips with no observer coverage, discards are estimated by stratifying the population of fishing trips and applying the annualized real time observed discard rate for each sector’s strata, and these estimates are applied to the corresponding strata’s unobserved trips. Discards count against a sector’s quota after adjusting for gear and stock-specific discard mortality rates. Vessels are assessed estimated discards on unobserved trips based on their strata, regardless of whether or not an individual species was reported on that trip. Sectors must have adequate quota reserves for all species in a given stock area prior to any member vessels fishing in that area.

7 George’s Bank is divided into a “west” component for which haddock and cod stocks are assessed exclusively by NOAA fisheries, and an “east” component for which these stocks together with yellowtail flounder are jointly assessed with the Canadian Department of Fisheries and Oceans under a trans-boundary management agreement.

As observer coverage represents only a fraction of the total fishing activity in the sector component of the commercial groundfish fishery, obvious question arise: Does data generated on observed fishing trips reflect the activities of the whole fleet? Are estimates generated from these data unbiased? Bias may be induced by either a deployment effect, where the assignment of observers to vessels is non-random, or an observer effect, where the fishing activities on observed trips vary in detectable ways from those on unobserved trips (Benoit and Allard 2009). These two effects, deployment and observer, may act separately or in combination to render data collected by on board observers biased. This paper focuses specifically on one component of the the latter effect: do individual vessels alter their behavior in response to the presence of an observer.

Why an observer effect?

Fisherman may alter their fishing behavior when carrying an observer for any one of at least five reasons: (1) people may act differently as a response to simply being watched, an established phenomena referred to as the Hawthorne Effect (McCambridge et al. 2018); (2) fisherman may not want to impart their individual discarding preferences on the other members of their sector, an effect driven primarily by within-strata target species and fishing practice heterogeneity; (3) observers incur costs associated with slower fish processing and handling times, carrying extra food, and general inconvenience, all of which may incentivize fisherman to make shorter trips when observers are on board; (4) catch of undersized fish varies across space and fishing in areas and at times where undersized fish are relatively less abundant may minimize discard rates, though presumably at a cost in terms of reduced total trip revenues; and (5) binding quota constraints impart strong economic incentives to discard legal-sized fish when an observer is not on board and to avoid these stocks in the presence of an observer, again presumably at a cost in terms of reduced total trip revenues.

This paper employs an exact matching method to determine if vessel performance along several metrics vary in a detectable way when an observer is on board, and when one is not.

Methods

Following a procedure laid out by Benoit and Allard, same-vessel trip sequences are analyzed to test for differences among various metrics. These trip sequences take the form of either: (1) three unobserved trips in a row (UUU), or (2) one observed trip between unobserved trips (UOU). To attenuate the possibility of interpreting seasonal effects as behavioral effects, only trips occurring within 45 days of each other are included. Trips are not repeated in multiple sequences. Vessels with less than two sequences are excluded from the analysis.

Triplet sequences are winnowed to pairs by taking the difference of either the leading or lagging trip with respect to the middle trip. The variable U in equation (1) and U^1 in equation (2), below, are selected randomly as either the leading or trailing trip in the triplet sequence, while the middle trip in the sequence is always the reference trip (O or , U^1 below). To mitigate against regulatory changes affecting fishing behavior within trip sequences while maximizing particularly the number of OU pairs for analysis, sequences overlapping the start of a new fishing year change (May 1 of each year) select only the lead or lag pair occurring in the same FY as the reference trip.

Differences are calculated as

$$\Delta O_{yfv} = (O - U/U')_{yfv} * 100 \quad \text{(Equation 1)}$$

$$\Delta U_{yfv} = \left(U^1 - U^2/U'\right)_{yfv} * 100 \quad \text{(Equation 2)}$$

where *y* is a fishing year, *f* is fishing vessel and *v* is any one of the metrics evaluated. *U'* is the mean unobserved value for each year, vessel and metric combination.
Metrics evaluated, *v*, are: (1) Trip duration; (2) Kept catch; (3) Total revenue; (4) Kept groundfish; (5) Kept non-groundfish; (6) Groundfish average price; (7) Non-groundfish average price; (8) Number of market categories included in kept catch.
The difference between the median values for ΔU's and ΔO's is calculated as

$$(M_{\Delta U - \Delta O})_{yfv} = median(\Delta U)_{yfv} - median(\Delta O)_{yfv}$$

(Equation 3)

Differences between observed and unobserved trips are tested for location differences[8] observed in $M_{\Delta U - \Delta O}$, with 95% confidence intervals estimated using bootstrap sampling (1,000 replicates) from the U_{yfv} and O_{yfv} values, where a lack of overlap with zero implies a 95% probability that the true median values for each population are significantly different.

<u>Data</u>

Vessel Trip Report (VTR) and Commercial Fishery Dealer (CFDBS) data are combined to construct trip-level datasets. Only trips for groundfish species are retained. For the post-Sector years, both Northeast Fishery Observer Program (NEFOP) and at-sea monitoring (ASM) data are matched to the commercial trip data.

UUU and UOU triplets are extracted and annual fishing year (May 1 – April 30) datasets are built with same-vessel two-trip sequences constructed from the UUU and UOU triplets.

<u>Results</u>

Results are reported based on two levels of aggregation:

- regulatory regime, as
    - pre-Sector years (FY's 2007-2009),
    - initial Sector years (FY's 2010-2012),
    - intermediate Sector years (FY's 2013-2015),
    - contemporary Sector years (FY's 2016-2017); and
- gear type, distinguishing between trawl and gillnet gears[9].

8 "Location" refers to the central tendency of the data, in this case the median values, and has no geographic connotation here.

9 Trawl gears include the Vessel Trip Report (VTR) codes 'OHS','OTB','OTC','OTF','OTM','OTO','OTR','OTS', and 'OTT'. Gillnet gears include the codes 'GNR','GNS', and 'GNT'.

Equations (1) and (2) are scaled by each vessel's mean annual values and median value differences are represented as percentages. For example, a median value of -0.042 for the kept catch variable implies that vessels catch roughly 4.2% less fish on an observed trip, relative to a neighboring unobserved trip by that same vessel, as measured across all vessels in the dataset. If the bootstrapped 95% confidence intervals fail to overlap with zero, the value is interpreted as significant using the confidence interval test.

Trawl vessels catch less fish when an observer is onboard. In the stanzas after 2009, they fish for less time and land less groundfish in particular. Statistical significance is obtained for kept catch in all four stanzas, and for trip duration, groundfish kept catch and total revenues in the three post-2009 stanzas. Groundfish average prices are statically higher for three of the four stanzas, the exception being the period from 2010-2012, indicating that composition of groundfish catch on observed and unobserved trips is different. Based on the reductions in catch and fishing time on observed trips after 2009, the changes in response to observer presence appear to be related to incentives embedded in catch accountability and the sector management system.

Gillnet vessels consistently made shorter trips, generate less revenue and appear to retain slightly less catch overall in the presence of an observer, but the results are more variable relative to trawl vessels. There is a trend in later stanzas toward more groundfish and less non-groundfish on observed trips for these vessels, indicating a difference in the mix of species landed in response to an observer. The increase in the number of groundfish market categories in the last stanza may indicate differential groundfish targeting, or perhaps high-grading of specific species. Statistically different behavior in response to an observer is equally prevalent for gillnet vessels and trawl vessels, but the magnitude of the effect appears to be slightly smaller for gillnet vessels. This may reflect a truly smaller behavioral response, or it may be due to a smaller number of paired trips, particularly in the later stanzas, or some combination of both. There is a less clear distinction in response before and after the implementation of sectors, where gillnet vessels demonstrated a significant response before sectors and trawl vessels, for the most part, did not.

<u>Discussion</u>

Fishing vessels alter their behavior in response to observers. Estimated median paired trip differences are zero for only a handful of the metrics evaluated across stanzas or fishing years. Generally, the most pronounced effects are seen across trip duration, kept catch, kept groundfish and trip revenue. Observer presence has the smallest effect on the number of groundfish market categories and non-groundfish average prices, but even here we see differences.

Incentives to alter fishing behavior have varied across time. Prior to sector implementation discards had no direct cost to fisherman and trip limits required discarding certain species. These factors may have reduced the incentive to alter fishing practices in response to an observer, noting that gillnet vessels did demonstrate a significant behavioral response prior to sectors. After full sector implementation, the accountability of discards and the application of sector/gear specific discard rates to unobserved trips, together with the potential catch of constraining stocks, increased the incentive to change behavior in response to an observer.

There may be off-setting incentives due to quota allocations, fishing preferences or other factors. One vessel may attempt to minimize observed discarding of flatfish at the expense of cod, while another vessel may take the exact opposite approach. Such offsetting behavior could change the central tendency of the distribution of $M_{\Delta U-\Delta O}$ very little, but may affect the shape of the distribution, particularly at the tails.

These analyses point toward a consistent pattern of different fishing behaviors when an observer is on board. The Benoit and Allard method isolates vessel effects by focusing on the differences in behavior in response to an observer *for the same vessel*. The data show a clear trend for three key metrics–in almost all circumstances vessels appear to retain less fish, fish for less time and obtain lower revenues when an observer is on board. Persistent differences such as higher average groundfish prices with an observer on board (trawl vessels) and emerging differences like a greater number of market categories retained with an observer (gillnet vessels) indicate that the composition of catch on observed trips is different. This suggests that data collected by observers are not merely a compressed representation of unobserved fishing practices but, rather, they may be non-representative along critical dimensions such as proportions and quantities of fish discarded and retained.

Consequences of EU landing obligation on Swedish sea-sampling programme in the Baltic Sea

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Cod fisheries in the Baltic Sea were the first demersal fisheries in Europe in which the landing obligation (LO) were implemented. The LO is a management measure that was initiated in EU Common Fisheries Policy 2013 and that is phased in fishery by fishery during 2015-2019. It principally means that individuals of all lengths for all fish stocks managed by a TAC need to be landed. Individuals with a length above the Minimum Conservation Reference Size (MCRS) can be sold for human consumption while individuals below MCRS are sold for other purposes. The LO constitutes a main shift in the EU Common Fisheries Policy and is intended to reduce discards, improve selectivity in fishing gears and improve the knowledge of the fish stocks as all parts of the catches are supposed to be landed.

The Baltic Sea is a large estuary in northern Europe. Only a few marine species are present in the main basin with cod being the most predominant demersal one. This mean that the demersal fishery targeting cod principally is a single species fishery and potentially ideal for a management measure such as LO. Data on the cod stocks is collected through the EC data collection regulations ((EU) No 2017/1004, Commission Decision 2016/1251/EU). Data on discards are included in the assessment of the two cod stocks. In the eastern Baltic have the proportion of cod discarded in the catches increased during the last five years (Figure 1). This is a consequence of reduced growth of the individuals in the stock. In commercial catches measured within the Swedish sea-sampling programme 2017 were for example only 13% of the individuals above 45 cm. Data submitted by countries participating in the fishery to the fish stock assessment working group (ICES WGBFAS) does further show that the fish below MCRS continues to be discarded despite the introduction of the LO (Figure 1). This might have consequences for the sea-sampling programmes as observers now might observe illegal behavior.

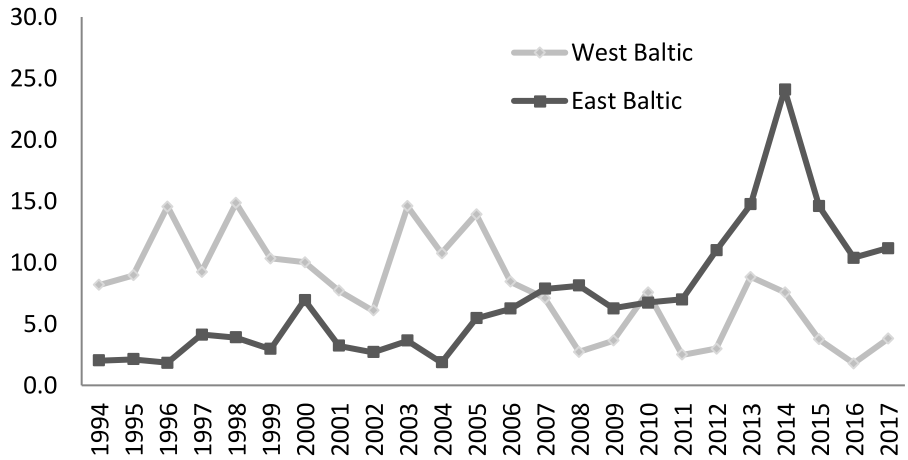

Figure 1. Percentage of cod discarded 1994-2017 for the Eastern and Western Baltic cod stocks. Catches combined from all countries and gears (passive and active). Data from ICES WGBFAS 2018. Decline in discards between 2014 and 2015 coincide with a reduction in MCRS from 38 cm to 35 cm.

The Swedish at-sea sampling programme started in the late 1990ies. The objective of the sampling programme is to generate data on exploitation, including discards, of the stock for assessment purposes. The observers have no role in control and enforcement. The aim has since then been to sample 24 fishing trips each year which used to correspond to approximately 1% of the fishing effort. In the beginning were vessels to be sampled chosen by the observers in an ad-hoc way. Vessels participated in the programme on a voluntary basis. In 2010 did Sweden, as a measure to reduce bias, apply a statistical design with a randomized selection procedure for vessels to sample. The random selection procedure also gives the opportunity to assess how well the programme is running. This success rate, that principally describe how many vessels that need to be contacted before a trip can be arranged, can be followed over time as indicator of risk for bias but also to monitor if there are changes in the fishery. Not all unsuccessful contacts are refusals from the industry. It can also be a consequence of limited effort by some vessels that make trips difficult to arrange. The random selection procedure worked relatively well during the first years and approximately one third of the approached vessels agreed to carry an observer within the given timeframe (Figure 2). In 2013 did the stock start to suffer from growth problems and the fishery deteriorated. This resulted in less willingness to bring observers. Two years later were the LO implemented and the response from the industry were that none of the selected vessels were willing to bring observers. Sweden had to return to an ad-hoc based vessel selection procedure. The overall result of the sampling was however poor and Sweden could for the first time not deliver any data on discards to the stock assessment working group. This resulted in the development of a new system and more support to the institute carrying out the sampling from the authorities managing the fishery. Vessels that have been selected for sampling does now risk a fine if they do not bring observers. This has resulted in an improved success rate. The main reason for unsuccessful contacts is presently that vessels have a low activity in the fishery. The new system has so far been successful but it needs to be evaluated if it has introduced new sources of biases. The first conclusion on consequences of the LO on the Swedish sea-sampling programme is that we can´t rely on vessels to participate on a voluntary basis.

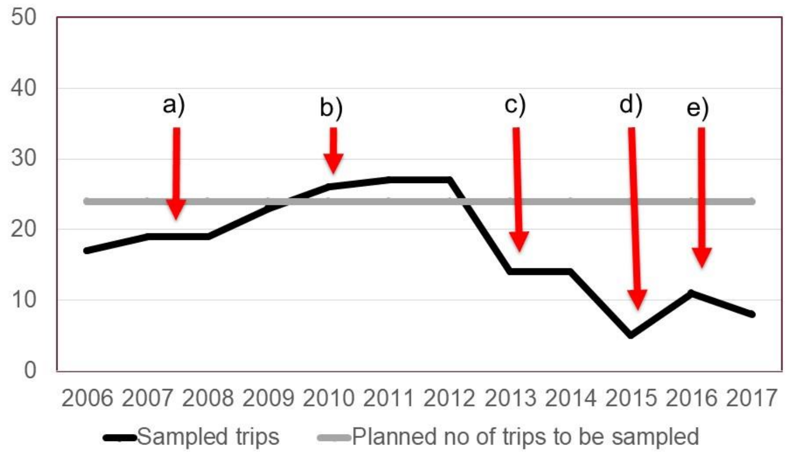

Figure 2. Showing planned number of trips to be sampled as well as number of trips sampled in the Swedish at-sea sampling programme 2006-2017. a) vessels selected on an ad-hoc basis, b) introduction of random selection of vessels to sample, success rate approx. 33%, c) fisheries start to deteriorate, success rate 10%, d) introduction of landing obligation, success rate almost 0%, return to ad-hoc sampling e) introduction of a new system where it is mandatory for vessels to participate in sampling, random selection of vessels, success rate approx. 33% due to few vessels in the fishery.

A second consequence of the LO is that is it difficult for the observers to assess if the cod below MCRS is landed or discarded, as discarding can happen at any time during the fishing trip. There might also be an observer effect, where more undersized cod is landed when observers are onboard. If, or to what degree, the undersized cod have been discarded is highly variable between observed trips. Discarding is an illegal act but it is assumed to be ongoing (Figure 1). A comparison of data (2015-2017) obtained though the at-sea sampling scheme with the official catch statistics (logbooks and sales slips) indicate underreporting of cod below MCRS in the official figures. Estimates from the sea-sampling programme show that 15-18% of the cod in the catches are below MCRS while the corresponding figures from the catch statistics is 2-4%. The difficulty for the observer to assess if caught undersized cod are discarded or not and the potential observer effect have led to a change in raising methods for the observed data. Instead of raising discards as such are we presently raising cod below MCRS based on the sampled trips. To estimate discards do we then deduct the landed undersized cod.

The second conclusion on consequences of the LO on the Swedish sea-sampling programme is that major changes in management measures such as the LO has an impact not only on the sampling but also on the raising of data.

Improving protocol of selection of vessels to reduce bias

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The goal of selecting vessels and deploying observers is to obtain data from trips that are representative of the fishing activity. Nevertheless, vessel selection is one of the major sources of bias for on-board sampling programs worldwide. Based on different ICES groups recommendations such as WGCATCH, SGPIDS and WKPICKS, IEO moved towards a probability-based approach in 2016 to reduce potential bias. This work presents results obtained in the sampling of the bottom trawlers operating in Northwestern Iberian waters -ICES Divisions VIIIc and IXa North- and discusses some of the metrics that can be used to assess at sea monitoring programs. Results show improvements regarding representativeness and coverage. At the same time, it's also noted some difficulties to fully implement the new approach due to practical constraints.

The Spanish on board sampling program coordinated by IEO has been traditionally developed thanks to the collaboration of vessels and fishing associations. In 2016 the selection of vessels changed from a previous ad-hoc selection -more likely to produce bias- to a random selection with replacement. List was generated based on the register of active vessels in the fishery to minimize sampling frame errors. The protocol included the full registration of responses into 6 categories including 5 different types of non-responses: 1-Affirmative, 2-Industry declined, 3-Not available, 4-Observer declined, 5 No answer, 6-No contact details.

The goal of this work is twofold. First, to analyze the bias produced by both at-sea sampling designs, i.e. the old ad hoc design and the new random design. And secondly investigate differences within the different type of responses received in 2016. In case of detecting bias, the aim is to obtain an understanding of the reasons explaining that differences thus allowing us to eliminate this bias of old or future estimates.

Our study fleet is the Northern Spanish coastal trawl fleet, which operates in ICES Divisions VIIIc (Cantabrian Sea and Northern Galician waters) and IXa North (Southern Galician waters). This fleet is made up of boats using two main gear types, the bottom otter trawl (OTB) and the bottom pair trawl (PTB). It lands around 50.000 tons per year, deploying an effort of about 15000 days per year (Figure 1).

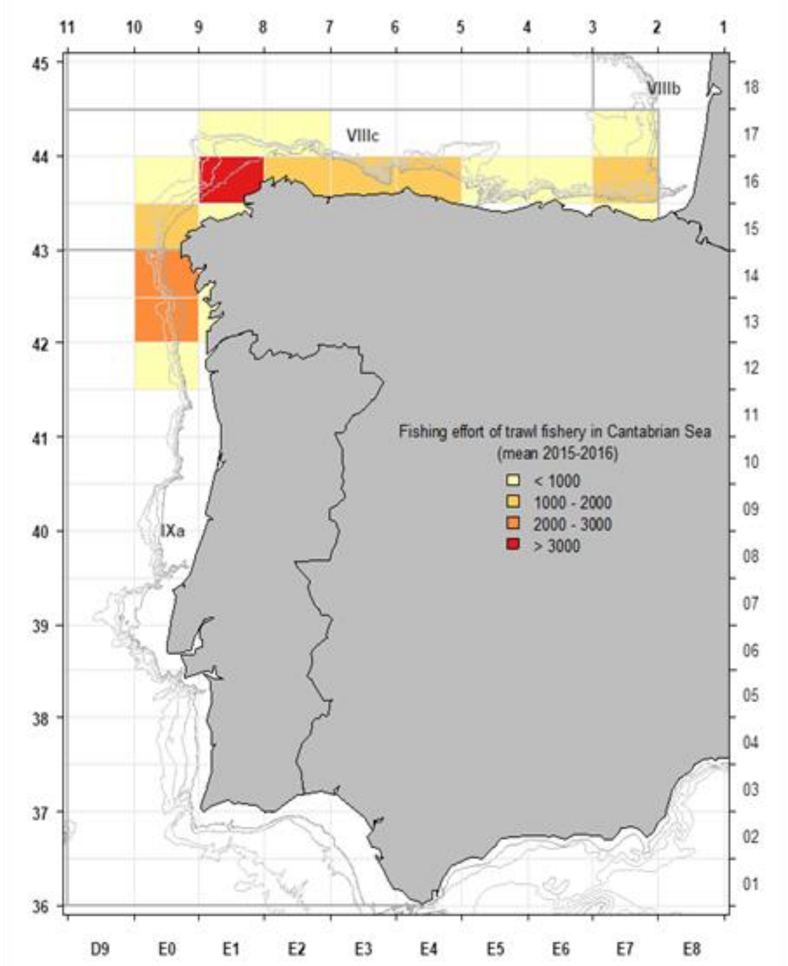
Bias was analyzed by comparing the landings registered in logbooks for the sampled trips against the total of unsampled trips to check if sampled units were representative of the fishery.

Regarding our first objetive, results show a significant difference between sampled and non-sampled vessels in 2015 that no longer appears in 2016. This represent an improvement in representativeness associated to the protocol of selection. As a derive result, the percentage of unique vessels sampled fishery increased from 19.8% in 2015 to 27.1% in 2016. This is a well known quality indicator and is in fact part of the new quality context which is used to evaluate national sampling programs under the current EU data collection framework.

In a second stage, the different 6 categories of responses were analyzed. The compliance of the random selection procedure was addressed with a 43% of affirmative answers, while direct refusals were only 9,4%. Deployment bias was mostly affected by temporal unavailability of the vessels – mainly lack of space—. In this case, significant differences within the different 6 categories were found in 2016 thus indicating non-responses were behaving differently. Pair wise test found significant differences between "affirmative" (group 1) and "not-available" responses (group 3). This unexpected result with not-available group could be reflecting a potential failure in the way fleet answers and responses are registered.

Deeper differentiation of responses categories could be needed and changes to distinguish real non availability cases are envisaged. Quality indicators and bias test based on logbook information should be included as periodical diagnostic tools within the sampling procedures. These kinds of diagnostics become more relevant in the context of European on board sampling programs, where scientific institutes have to provide discards estimates and are currently facing a new scenario with the implementation of the landing obligation.

Figure 1. Days at sea for the studied trawl fleet (mean 2015-2016).



Open Discussion Session

Q - I think this is directed at Chad and Jose. Regardless of human or EM there is obviously an observer effect on extreme side you have Alaska groundfish fishery where you have instances of water holes or pre sorting of halibut or salmon and on the mild side you might have modest changes in operation or a different technique is as a couple you pointe. The only place I've seen where it seems like there just a simple solution addresses the Hawthorne effect. And Steve can correct me if I'm wrong but the Australian gummy shark fishery gillnet fishery there is a 100 percent observer coverage. You sow obviously there is no bias if there is less opportunity for bias if everyone is covered. That does not equal for everyone. But the one aspect that I don't think any of the speakers addressed and it is important and that's the issue of biased observers. There are observers that are selected more often by the industry. If it's not a randomized process and they go out on vessels more frequently than other observers and there's kind of an unwritten understanding that you know that they're providing information that should be considered suspect You know how

do you deal with the bad apples that give all the observers a bad name ultimately and provide data that is not true is not honest.
A - The last part of your question on observers. It's not something that we face in our programme because we are using our own team sampling team and we are not dealing with people from a company with the industry. Our team is belonging to the institute and is only working for us.
A - Chad Demarest: Way outside the scope of at least that portion of the work that I was trying to talk about which is obviously on the vessel side. When you start to dig into the quality of observer data the mind starts to boggle or at least it should because observer data is really heterogeneous it's going to depend on the estimation method like you said it's going to depend on the observer could depend on the interface of the observer in the vessel. I think there are probably techniques to look at that. That's a very involved process but it's important work and I hope that somebody in this room other than me takes it up.

Q - My question is to Chad and to Anna. Assuming the unobserved trip the data you was from the logbook. The data from the unobserved trip did they come from the logbooks information – self reported?
A - The information from the unobserved trips is dealer data.

Q - I noticed you had been looking at data and similar analysis in the southeast comparing observer chips versus what is reported in the logbooks which means something similar to dealer data. In the self reported data I saw that you looked at you know before catch shares and after catch shares. To me one of the first things to start looking at is that unobserved trip data changing over time as well due to management practices. I'm wondering if you examine that at all in your analysis when you compare the unit prep versus the observed trips.
A - I think that's going to be tricky to tease out because of the regulatory impacts. The things that are going to drive behavior change are hard to isolate. It's not just the presence of an observer it's the regulatory changes. I suspect that there's ways to get it right. I don't have a great answer for you ready for sure. But I think that's a really good question and I think that it's unanswerable question.

Q - Okay well that's the reason that I asked is I'm dealing with the same issue in the southeast and I was wondering how you might have approached that because I'm seeing changes in self reported data and it kind of hearing back to help management is changing and the industry will report some differently depending on how the management may be driving it one way or the other. That data is biased then it becomes hard to compare it with the observer data. So you have all these biases you know conflicting against each other.
A - But isn't that the important point though that at the end of the day we need to understand how representative the observer data are for the intended purpose when talking about estimated discards. But there's also this compliance aspect to it for illegal discarding of legal sizes fish. The aspect of content reporting of changes in reporting over time still might lead to a regulatory responsive increase of observers or altered technologies.

Q - For decades I have been working with observer data in different Argentinian fisheries, and regarding to discards I have noticed differences that can be considered when analyzing the causes of bias in the estimates of discards. These differences show a direct relationship between the amounts of fish discarded and the CPUE or yield. When CPUE increases

discards also does it, both for target species and for accompanying fauna (bycatch), increasing the discard of larger sizes of fish compared with when the CPUE is lower.
A - Certainly when there are greater catches, discards tends to be greater due to restrictions to keep all the catch onboard. However, other causes that may cause discards must be considered, including quota limitations in multi-specific fisheries, where different species of accompanying fauna (bycatch) are at the same time target resources for other fisheries. In those cases it is possible that the discards are not necessarily caused by the amount of catch, but rather by the impossibility of retaining bycatch on board (due to quota restrictions). In Chile the main limitations are the catch quotas for the species of accompanying fauna (bycatch). We are currently studying how to modify the percentages of authorized bycatch, to allow (improve) their use.

Q - In Argentina there are still no provisions to manage the discard by quotas, but it is remarkable for example how even for allocated species (species with quota), which are targeted by a specific fishing set, their discards increase due to lack of processing capacity onboard. The fishing vessels fail to process everything they catch and often there is a remnant that is discarded
A - In Chile, most of the discarded species are not bycatch species (accompanying fauna), they are actually target species. It is interesting then because the work that must be done to reduce the discard is to find the alternatives to try to encourage fishermen to use all the catches. Naturally, in Chile also occurs what happens in other countries, where fish is discarded by size as well. Fishermen try to retain the most valuable fish and generally these practices are concentrated on the target species

Q - Question for Anna and maybe for Chad. If I understood the presentation correctly and you were talking about mandatory discards and prohibited discards and you know more about the mandatory discards of the prohibited discards. Is that correct.
A - We estimate mandatory discards like that's what's collected for unobserved trips and then that's what we use to estimate discards for the unobserved trips. Prohibited discards we never see so but there are incentives on unobserved trips for them to exist.

Q - So is do those types of discards have any relation to the retrospective pattern that's appeared and stock assessments for certain species and feel free to explain what a retrospective pattern is if there's something to it if it really off base don't worry about.
A - Well I'm not a stock assessment scientists of retrospective patterns or out of my wheelhouse as well. Certainly there's potential that that's related to the potential bias in catch data from prohibited discarded not existing in those catch data. And there are other folks who are working on trying to kind of determine that but I'm certainly not the person that would know most about that.
A - We're going through a process right now with New England groundfish looking specifically at the coverage rate the style of coverage whether it's technology or humans not humans aren't technical but I totally illustrates that whatever. And one of the things that comes up a lot is your question what is the relationship between monitoring and improving the quality of the stock assessment. So for those in the room that don't know what the retrospective patterns are they're being referred to it's just that our stock assessments for certain really economically important stocks have not performed very well over time. They don't seem to predict fish mortality rates etc. That could be related to problems in the catch data that could be related to problems with natural mortality or other changes that are

outside the scope of monitoring necessarily. I think the most important thing though and the thing that Annas shows and mine as well that these changes over time. If captains are responding to these incentives in ways that would make sense to an economist and to a small business owner that can have a profound effect on even small changes can have a profound effect on the assessment performance because of the way that age structured assessments work. But the other thing is that when we're talking about improving monitoring in groundfish. I personally feel like it's a bad idea to tie that to assessment performance because for example if you captured your mortality really well with 100 percent monitoring in the first year you would drive up in the assessment and crash the fishery and life would get really ugly for a lot of people. So that's really not that I look at the fairness and equity thing especially in a quota management fishery where people are paying for quota. The fairness and equity associated with not being able to or some people not being willing to take risks that others are other are.

Q - This isn’t actually a question, I thought I would take up the challenge of addressing biases in observer sampling because camera has virtually 100 percent observer coverage for us in all fisheries. Actually on a lot of our vessels we have multiple observers, and for a number of years we have spent time requiring observers to record which observer recorded what data and we have done extensive analysis on it. And it kind of turns out like with captains, that observers don’t really like being watched either, and they actively try to avoid knowing who has done what, believe it or not. So the whole question of bias about observers and what they collect is actually pretty messy and not easy to quantify.

Q - I have a question for Chad. I'm not sure if I understood are you actually modeling a de facto 30 % coverage rate when you're looking at unobserved observe them and observe the model.
A - No I'm just taking the data as it's given and so you'll see the variance in this stuff blow out in the observer coverage goes down. So the pool of the observed relative to unobserved trips shrinks a lot. It was like 11 percent observer coverage realized in the most recent year because fishing is so variable. You'll actually see the 97.5 and 2.5 lines at the whiskers at the end of those box plots do overlap with zeros so those are not statistically representative results. But the trends seem to work out and I think that's mostly kind of a power driven thing. We just don't have enough data in with the low coverage rates we had more coverage trips we'd have more pairs in that oh you thing and varians which shrank on those estimators and I suspect that we'd have more solid results.

Q - Okay so then do you see that observer effect sort of swap out as you increase observer coverage or do you see that the type that your metrics get closer together as far as what an observed trip looks like when the coverage increases.
A - No I don't actually see any change in the central tendency I see just blowing out of the variance because at the lower end. But no I don't see that and I think there's a lot of reasons why because fishing is such a complicated thing not everybody has the same incentives. Not even in the same the same month of the same year with the same gear type have the same incentives. So there is a lot of washing out. So I don't see a change with respect to the central tendency and the observer coverage rate.

Q - Just curious whether you guys who use observer data. How you examine the data in the first instance before you use it for reporting. It might depend on the fisheries that you’re

involved in, but for example in New Zealand we do some trips where they fish 24 hours a day and we put two observers on and it’s still one observer trip. But often, same vessel we put one observer on. Now we get our observers to record the fact that when they are not on shift, cause we won’t let them work more than twelve hours a day. That figures they record are coded so we know those vessel figures. But it just gets really you know, you just say this is an observer trip and here is the data and they are quite different things when you’ve got a mix of observer recorded vessel collected data or information, particularly of effort, compared to all observed collected independent data and I’m just curious whether you guys ever considered factoring that in or whether it is even an issue in your fisheries or programs.
A - In our case and in my presentation data was based on official logbook data that of course work with our survey data to make estimations about fleet landings and discards. We do know the number and hauls that you are covering. I could expect my team to be working 12 hours per day. I know how many hauls they are covering within the trip and we use that information to raise everything to fleet level. I can compare as we are having the same kind of units for the official data.
A - I mean I know that in our case the fisheries sampling branch does a lot of data cleaning and quality when they get the data from the observers and then so that happens before it goes into the database. But then when we use it I think it really varies depending on what you're using it for but like for example in the Northeast you know catch estimation methods. There's the gamut of lack of volume to volume estimation versus an actual scale measurement. And I think often times those are all just compiled and treated the same. Even though the accuracy and precision of those are very different. So I think it's something that's important to remember when using observer data is how heterogeneous it can be and I think often that that point does get lost.
A - In Chile it has been difficult to have coverage of 100% of fishing trips with observers onboard (trips not hauls). Our study analyzed data from fishing trips where there was also an observer onboard. Trips without an observer were taken only as reference information in order to compare the level of information provided by captains and observers. There are indeed differences when there is an observer on board (observer effect), since the behavior of the crew changes. However it is difficult to quantify those differences or changes in behavior.
By the end of 2018 EMS should start operating in Chile, and then the skippers will have to provide reliable information. These systems will promote the supply of reliable information by skippers.

Q - I don't really have a question. More a comment to what has been put forward. In Greenland we have had discard ban for more than 30 years and we introduced the observer scheme 30 years ago because we discovered that we had a massive high grading problem in our shrimp fishery. Through the years we have collected catch information catch composition the vessel must report catch composition size groups of the shrimp's and that have enabled us to keep a very precise track of the performance of each vessel. That can be used now as what we call risk based assessment because we started out two to observers 100 percent coverage. Now we're down to less than 50 percent coverage and with only one observer. When collects all these data you can measure the performance of the masters of these big shrimp vessels. A side effect is that you could also measure also measure performance of your observers and that would be reflected in the briefing of the observer

here. So, when you have established a system of data in your system here then you can keep a very precise track on the performance of each of the vessels.
I apologize that I am slow because I want to have some remarks to students with previous panels. It strikes me that we should make more effort in explaining the fishermen that a more precise reporting of discards and things like that can actually lead to any increase of the TAC and quotas. We have seen that when we got hold of our catch reporting in the shrimp fishery we were actually able to increase the TAC. And I know from the Barents Sea cod have also experienced that in the last five years the quotas have been increased because of the catch report. And I think also that the President of ICES mentioned that when you have the information from the fisheries that will be of benefit for the fishermen at the very end.

Q - I'm thinking the presentations is really helpful to help think through this stuff. So I've heard a lot about how that vessel could potentially bias observer programmes and then some comments about how veteran observers could bias the observer programs. One thing that wasn't mentioned that I think in my opinion is a huge amount of potential to bias programmes is the weather and I was curious if any of the panelists thought about incorporating anything to do with whether into their analysis and to take it one step further. You know, you could you say while the weather happens on all trips so we just considered it that we had a wide enough sample size it didn't matter. But for example in New England some fishermen if the weather is bad and then they get selected for an observer that might be just enough to push them over the top and say I'm actually not going to take this trip. So there could be a bias on observed trips versus unobserved trips due to weather conditions. I'm curious if anyone accounted for that?
A - I think that might fit under the rubric of a deployment effect analysis.
A - It's true that was never used. Weather conditions could be nice to have an to analyse. We have never seen any observer that was refusing to go on board any vessel because of the safety of the vessel nor because of the condition of the sea. As you could see in my analysis but it's through hat it could happen. It didn't happen. We don't have weather condition information data in the database. We don't have data metrological conditions. I have to say that I could imagine that to do something like that. You really need a good a very big pool of trips to analyse because when you start to take into account all the vessel characteristics, the law, the landings, the discards. I mean there are so many variables that you can play with that you get a little crazy with all the output and you need every time you stratify using one of them or you're trying to do something that you really need a good data set. That could be a problem

Q - Thanks for the panel. I really appreciate the diversity of fisheries that you represent and the data that you're working with. So I'm going to put my question out to Marcelo at the Chilean hake fishery has something caught a question sort of getting at how the ground truth the difference between the reporting of what the captains are reporting and what the observers are recording. So Marcelo I was curious to know in your in your presentation you reported that captains don't report any hake discards so far and I'm wondering what do you attribute that to and what would you ground truth things. So what process are you using and can you reach out to these captains and ask them why is it just a new thing that they aren't doing or is there something more nefarious. What do you attribute your results to?
A - In the case of the crustacean fishery, it has a strong interaction (bycatch) with common hake, a fairly important resource for several other industrial and artisanal fleets. As it was

mentioned at the beginning, the regulations and fear to sanctions induce the skippers of crustaceans fleets to not declare hake catches as bycatch (accompanying fauna). However, it is interesting they did not inform hake during the research project on discards, since by law during these studies it was allowed to declare all catches (including hake) without penalties or quota deductions, in order to know the real amounts caught without bias to subsequently adopt the necessary measures to reduce all discards.
We all know that there is bycatch (accompanying fauna) in all fisheries and that bycatch is an inherent part of the fishing activity that must be reduced with, for example, measures or changes in selectivity. However, it will not be possible to reach zero bycatch.
I do not understand why the skippers did not declare the exact information about bycatch during the study. It seems to me that their intention was to give the image of a clean fishery that had no effect on other non-target resources, especially when they actually have a direct competition with another important group of fishermen (common hake fishery). Regrettably, the quotas for hake were already established without good information on its bycatch in other fisheries and without the necessary adjustments that could have been made. Now the crustacean fishermen themselves have to adapt to the restricted quantities of hake (accompanying fauna) allocated for crustacean fishery, that they themselves declared (under reported) and that we detect during the study.

Q - A follow up question. You said now they're going to you're going to start putting cameras on the boats. This is if there is a lack of reporting and then there's an eye on what they're doing and big change their reporting. This could cause problems. Just thinking about how to bring electronic monitoring in a way that has the fishermen willing to embrace rather than resist. I know that's kind of a hard question to answer quickly so we can talk later.
A - From now on, fishermen are bound by law to incorporate EMS in their operations, it is not an option to want it or not. Who does not operate with EMS will not be able to fish. The discard reduction plans established are adaptable and can be improved as long as we have better information that EMS will provide.

Q - This is a question for Chad and Anna. I know that in the Northeast you also help the industry funded scallop programme on its. Motivation putting an observer on those fisheries is very different than groundfish and I'm wondering if you have thought about or have analyzed any observer bias effect in the scallop fishery and if you have it or maybe in future analysis.
A - I haven't done any work on that.
A - So this is going a little further far afield from the work that I presented today but I'm also interested in the spatial aspect of observer bias and I was doing a lot of work on groundfish looking at that and one of my colleagues suggested I try to find a fishery that might not have a strong bias incentive and he said you should look at the scallop fishery and just to compare it to see if these results look substantially different. And so I did and I think this scallop fishery has a much different but also equally profound level of observer bias which is not what we expected to see and I didn't think a lot about that but I think it also might be mostly on the deployment side. I think that there are some incentives for spatial deployment that are different than the behavioral effects that I was looking at in groundfish. But again I haven't followed all that up yet. And so that's just kind of my initial inclination.

Q - So here we've been mainly talking about the trawlers but I would also ask about long liners and this kind of bias for the large pelagic fleets and specially long liners when the

deploying observers. Many times conditions and the security of the vessels and by a vessel be the nice enough to get an observer onboard. In reality when we get to the information and for estimation of bycatches we get the information from the good boys from the fleet and we don't get any information from the bad boys from the fleet. So, I was just curious to know if the effect set at European level on strategy of selection of vessel in order to avoid bias in this kind of information or how we can address such a problem?
A - Not sure I got everything of your question. I mean that things we now are doing in planning to deploy observers on vessels are that we generate in simple random selection from the list of vessels where all vessels are listed, meaning census data. We just randomly select the vessels to call for deploying an observer. So we don't make any kind of assumption about the vessel history based on last year activity or on the vessel safety, nothing at all. We just go on as you have seen. We record every response from the skipper in order later to see what was happening if something is being hided. In the example that I showed in the case of 2016 we were very happy because the sampled vessels against the total fleet was not at all biased when comparing landing estimates. But as you could see also within the list of vessels there are six different categories we could find that something is not working for is not a available group. It is interesting to identify which vessels are they? If they are behaving different in those cases when we are calling or in other cases when we are not calling them. But, I mean my big surprise with this is simple analysis for us. It was so simple to do this from the very beginning just to create the list and not take nothing more into account.

Q - This question is for Katja. So you talk about the impact of the landing obligation has had on your monitoring in some of the data that came out. But I think one of the biggest issues that is coming up in Europe is the impact on scientific advice in the stock assessment that goes after that so my question is are you doing something, are you analyzing that or do you plan to do it in the future.?
A - I think what I think what we are doing or are trying to do is keeping the scientific integrity of the data that we collect. And that's what we try and we got this collaboration with the authorities to grant ourselves access to the vessels. We tried to, instead of actually observe discarding instead of observe catches. This to try to avoid ourselves to observing to many illegal things because I really think when Europe is moving into the landing obligation the integrity of scientific data in particular those comes from the fleets it's one of the central things to try to keep. So that's in the line we're working but we are not 100% there but of course we need to look at other types of biases arising for this when it turns into more mandatory system.

<u>Poster Presentations – Extended Abstracts</u>

Low number of cooperative vessels: Can they conform to a reference fleet?

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Introduction

Major sources of bias on onboard sampling for fish catch data collection are related to vessel selection, catch sampling and changes in fishing behavior in the presence of observers. The Portuguese onboard sampling programme for the EU Data Collection Framework (PNAB/DCF), is based on a quasi-random sampling of cooperative commercial vessels. One of our concerns is related to the low number of cooperative vessels included in the sampling frame that is justified by several types of refusals. Representativeness of the samples is critical for obtaining accurate catch estimates and information about the main factors for mitigating by-catch. This study focuses on the otter bottom trawl fleet, comparing vessels characteristics and fishing activities using trips from the target fleet and trips from the sampling frame with and without observers on board.

Material and Methods

The analysis is carried out for the period 2012-2015 using data collected by the Portuguese onboard sampling programme, included in the National Programme for Biological Sampling (PNAB/EU/DCF), and data derived from logbooks and vessel monitoring system (VMS) provided by the Portuguese Administration (Directorate General for Natural Resources, Safety and Maritime Services - DGRM). The fleet selected for the study was the fleet size segment [24m-40m[from the otter bottom trawl fleet targeting demersal species with cod-end mesh sizes of 65-69 mm or ≥70 mm (OTB_DEF_>=65_0_0), operating off the Portuguese continental coast (ICES Division 27.9.a). A set of species was selected according to their importance in total landings weight from this fishery (representing around 80% of total landings): *Merluccius merluccius* (European hake), *Trachurus trachurus* (Atlantic horse mackerel), *Micromesistius poutassou* (Blue whiting), *Trachurus picturatus* (Blue jack mackerel), *Scomber colias* (Chub mackerel), *Trisopterus luscus* (Pouting) and *Pagellus acarne* (Axillary seabream).

Variables included in the cluster analysis (trip) were the number of fishing days, number of hauls, quarter, ICES rectangle codes, total landings (all species), “Individual Vessel Quota” for hake and proportion of each species in total landings. Clusters of trips were identified using multivariate data analysis (CLARA). In relation to the observer effect, relevant variables in clustering were compared within clusters and, for trips with and without observers onboard, analyses were based on agreement rate by fishing zone, fishing pattern, landing profiles and proportions of species in clusters.

Table 1. Summary of the data used in the analysis: Fishing (logbooks) and sampling (onboard) effort along with the number of observations (combination of trips/days/ICES rectangles).

Year	Number of trips		Number of observations	
	Logbooks	Onboard	Logbooks	Onboard
2012	4711	31	10829	46
2013	5243	27	12455	46
2014	5069	24	10997	35
2015	5294	26	12169	43

Results

Multivariate analysis indicates two groups of fishing trips within the target fleet (cluster A and cluster B), persistent in the analyzed period, with distinct fishing regimes, total landings

and main landed species. The fishing grounds exploited during the sampled trips did not deviate from traditional fishing grounds (Figure 1). The mean agreement rate for the analyzed time period was 81% in NW, 62% in SW and in S of 60%.
Figures 2 and 3 also show that no differences are found between the fishing activity of the vessels of the sampling frame and the vessels from target fleet as well as no observer's effect in sampled trips.

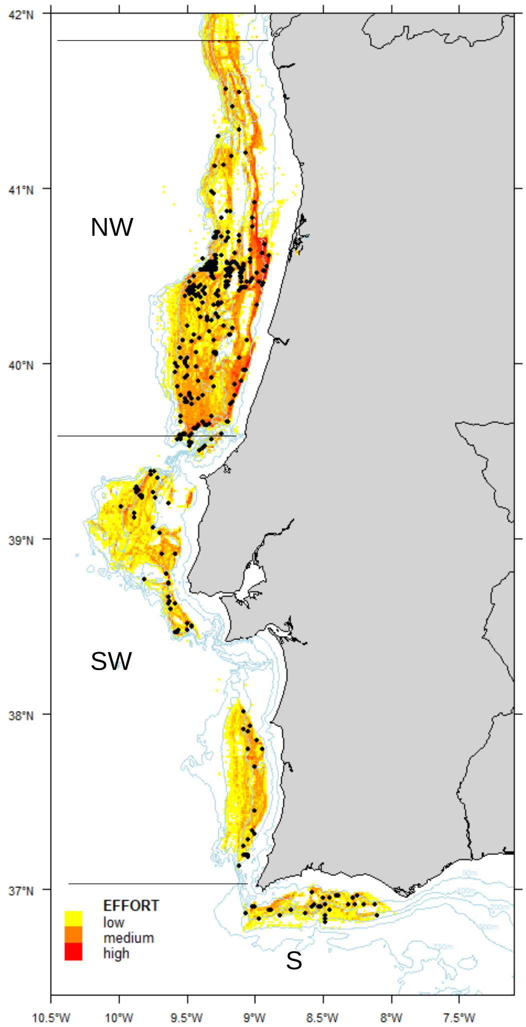

Figure 1. Fishing effort distribution of the target fleet and of trips sampled from the sampling frame (black dots) along the fishing areas in 2012-2015.

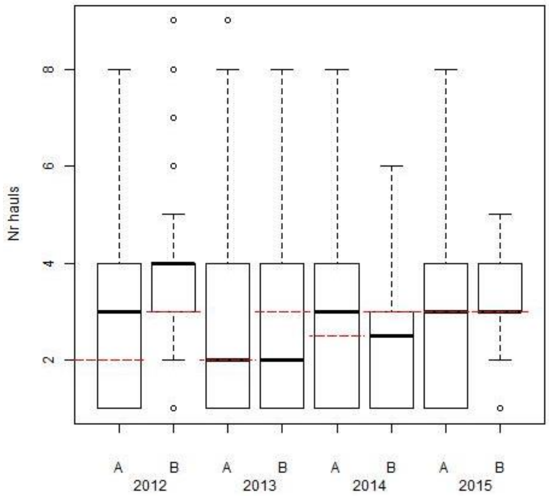

Figure 2. Fishing effort by trip of the target fleet by cluster (A, B) for the period 2012-2015, and the median value of sampled trips (red dashed line).

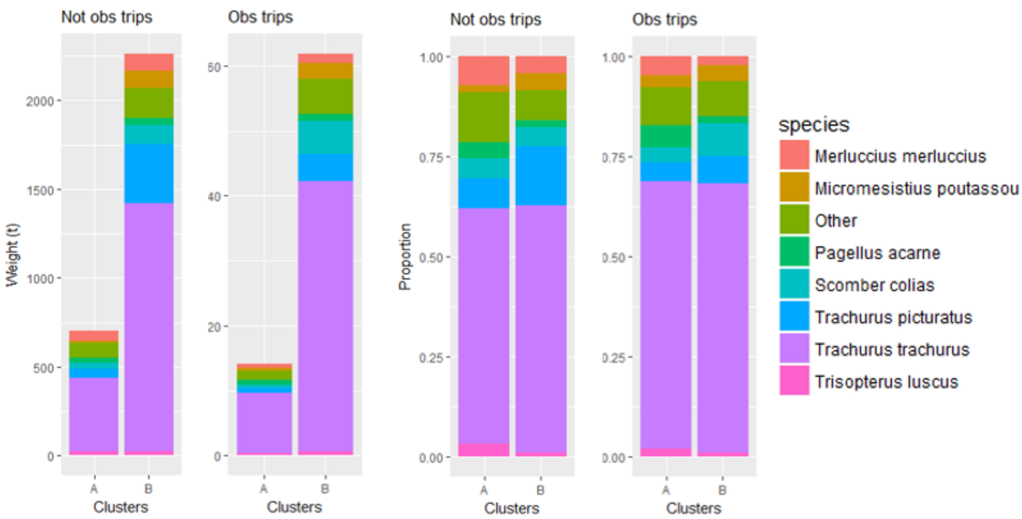

Figure 3. Species composition of landings within cluster for trips with and without observer onboard. Two left panels: Landing weight of dominant species in catches (80%); two right panels: Proportion of species in total landings.

Final remarks

Two different clusters of trips separated by characteristics/factors like fishing grounds, fishing effort, fishing season, management regime and target species were identified; they are spread along the coast and between quarters. Differences between clusters are mainly related to the landing profiles (Figure 3). The sampling frame includes trips from both clusters and they follow the same tendencies as trips from target fleet. The study also revealed that the presence of scientific observers onboard does not bias fisheries catch data.

From 2018 onwards, the adoption of the sampling frame as a reference fleet for the Portuguese otter bottom trawl fishery will be considered. Also, the use of clustering to improve discards estimation in this fishery will be investigated. The possibility of applying this methodology/approach to the Purse Seine fishery will be analyzed.

Acknowledgments
We thank the skippers from the cooperative vessels for good collaboration with science, the team of scientific observers from PNAB (IPMA) for their great commitment and the Portuguese Administration (Directorate General for Natural Resources, Safety and Maritime Services – DGRM) for providing logbook and VMS data.

Seabird interactions and catch in Alaska trawl fisheries – supplemental data collection revisited

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Abstract Trawl bycatch in Alaska fisheries is an extremely rare event and challenging to monitor using standard observer sampling methods for species composition. New protocols were implemented in 2010 to monitor parts of the gear retrieval process which increased the likelihood of encountering seabird catch outside of the standard sample. Catch rates varied widely by target fishery and processing type. Catcher-processing vessels (CPs) targeting Pacific cod in the Aleutian Islands (AI) had the highest catch rates. Pacific cod motherships in the AI and deep-water flatfish CPs in the Bering Sea also had consistently high rates. When birds encountered in a supplemental sample were added to a subset of current estimates, the new estimate of total birds increased by nearly 20%. Supplemental sample data should be incorporated into the annual seabird catch estimation process. In addition, current protocols for reporting supplemental seabird mortality on trawl vessels could be improved.

Introduction

Seabirds are sensitive to anthropogenic mortality due to their life history characteristics (e.g., long-lived, low fecundity). Seabirds are attracted to fishing vessels due to discards of whole fish and offal and this dynamic may be related to time of year, target species and type of offal discharge. Once in the vicinity of the vessel, birds may interact via vessel collisions, net cable collisions or net entanglement. Alaska trawl fisheries currently account for approximately 691 seabird mortalities per year (2007-2015 average). Quantifying seabird interactions and mortality is more elusive in trawl fisheries compared to other fixed gear types such as longline because catch is less likely to be landed on the vessel or if landed, may not be encountered by the fisheries observer. Birds caught outside of the standard species composition sample are not currently included in the NMFS Alaska Region (AKR) estimates of birds caught. The North Pacific Observer Program (NPOP) included additional seabird monitoring protocols in 2010. We summarize seabird mortality using standard observer sampling and supplemental seabird mortality observations on trawl vessels and compare current fleet-wide estimates of seabird catch to estimates which include supplemental bird catch.

Methods

Gear description: Trawlers in Alaska utilize the otter trawl, in which two warp (main) cables connect the vessel to trawl doors which keep the net open horizontally (Fig. 1). Net monitoring systems used by some fisheries add a third cable (wire) to the trawl operation.

Fishery description: Alaska fisheries occur over a wide geographic range. Alaska trawl vessels may catch and process fish into frozen product on board (Catcher-processors - CP), catch and deliver their catch to either a shore-based processor (catcher vessels - CV) or an at-sea mothership.

Data/Analysis: The NPOP supplied standard observer sample and seabird interaction data for 2010-2015. Observers deployed to 184 unique vessels and sampled 194,498 hauls. All bird catch was re-coded into 3 categories: included in standard observer sample; not included but could have been encountered by standard sampling techniques (e.g., found in factory bin outside of sample period); or not included and not likely to have been encountered (e.g., caught on cables)-supplemental sample. Mean # birds / 100 hauls calculated for standard and supplemental samples.

Seabird catch comparisons: The NMFS Alaska Region (AKR) provided total retained fish and seabird catch estimates for all strata used for their fleet-wide extrapolation process. Seabird catch estimates from observer samples (including supplemental sample) were compared to AKR estimates for similar strata. Comparisons were limited to CPs and motherships with all hauls sampled within each permit, trip, target fishery, management area and gear type combinations and when the sum of extrapolated observer estimates and AKR estimates were nearly equal (within 0.1) within the same strata.

Results

Bird catch and rates: Birds were caught in 0.14% of sampled hauls. Catcher vessels had the lowest bird catch rates whereas CPs had the highest. Pacific cod motherships and CPs in the Aleutian Islands and deepwater flatfish CPs in the Bering Sea (BS) had the three highest bird catch rates based on standard observer sampling whereas Pacific cod and rockfish CPs in the AI and deepwater flatfish in the BS had the three highest rates from the supplemental sampling sources (**Error! Reference source not found.**2). BS pollock and shallow-water f latfish CPs have relatively low catch rates; however, due to the high effort by these fleets, overall bird catch is highest in these two fisheries.

Seabird catch comparison: The subset of catch estimates examined accounted for 56% of the retained fish catch weight and 91% of the AKR estimated bird catch from 2010-2015. When supplemental birds were included by simply adding them onto the AKR estimate, the new estimate of birds increased nearly 20% to 3,124 total birds. Of this estimate, most were northern fulmars (*Fulmarus glacialis*; 72%) followed by shearwaters (*Ardenna* spp.; 13%) and Alcidae (8%). No Laysan albatross were encountered in standard observer samples resulting in a zero estimate; however, supplemental sampling (without extrapolation) accounted for a catch of 44 Laysan albatross.

Discussion

Seabird bycatch estimates are currently underestimated since they are based only on standard observer samples. When birds encountered in the supplemental sample were added to a subset of current estimates, the new estimate of total birds increased by nearly 20%. Supplemental bird catch information could be integrated into the current seabird catch estimation process by simply adding the supplemental catch that had no chance of ending up in the standard sample to the AKR estimates. In the future, it may be useful to explore the validity of estimates using ratio estimators that have more operational relevance to seabird catch such as trawl duration (time cables are a risk to birds) or tonnage and type of discard which may impact the number of birds attracted to the vessel and at risk of interacting with the gear.

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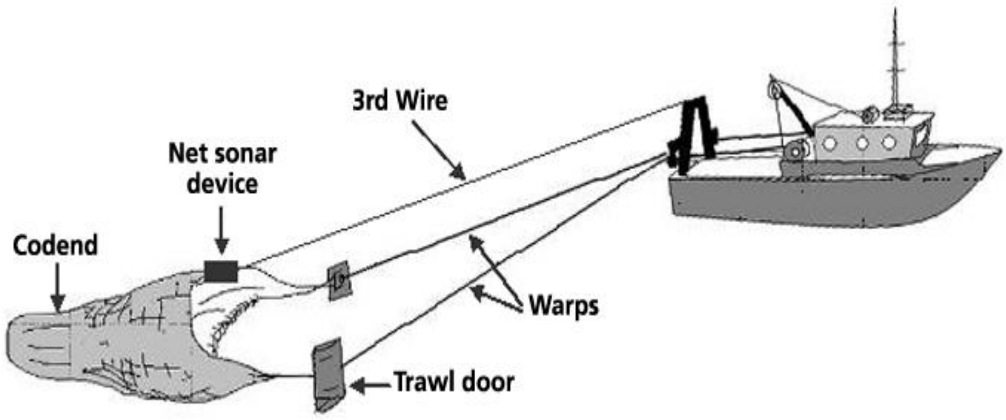

Fig. 1 Generalized trawl gear diagram (Courtesy of K. Williams, NOAA Fisheries).

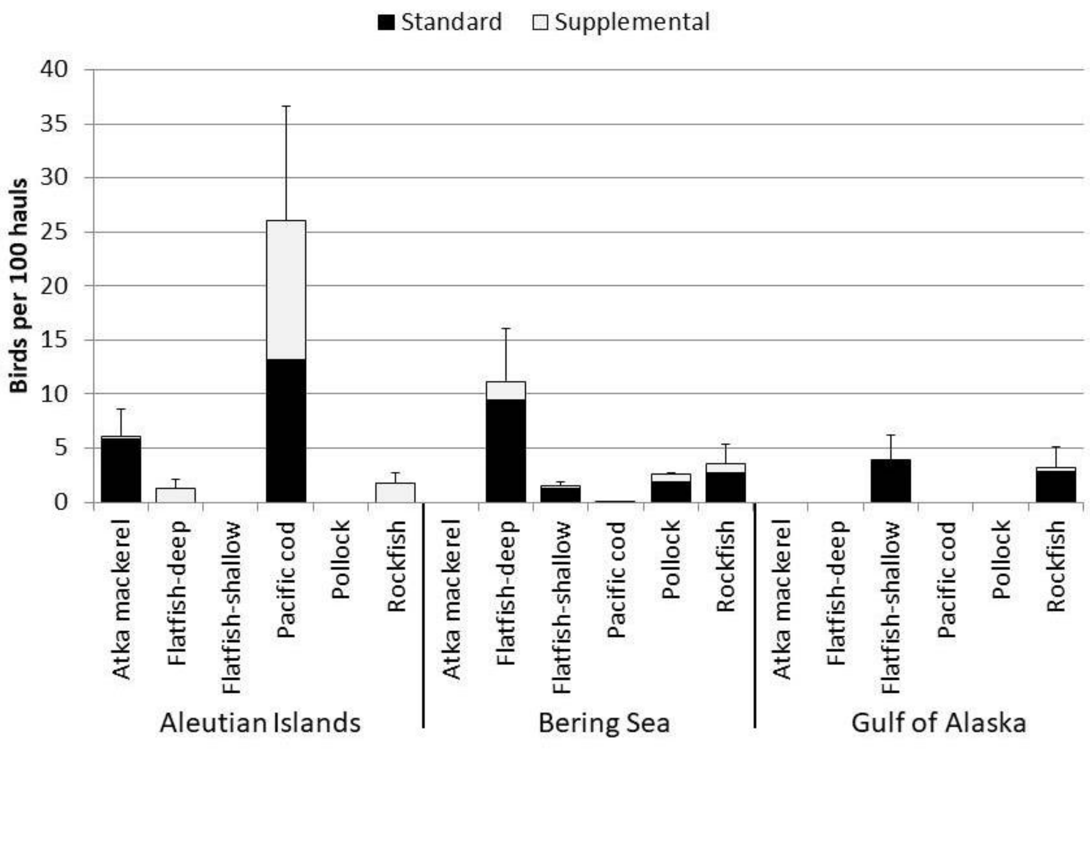

Fig. 2 Birds per 100 hauls for catcher processors by target and large geographic area. Error bars are SE on total birds per haul.

Survey sampling for fisheries monitoring in Brazil: implementation and analysis

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Brazil is among the countries with difficulties in maintaining a permanent and reliable fishery data collection system. Among the reasons for this situation is the fact that the national fishing statistics have been heavily influenced by changing institutional and political arrangements over time (Dias-Neto, 2010, 2011; Lima-Green & Moreira, 2012). Several government institutions were granted the formal and uncoordinated assignment to survey and produce statistics of the Brazilian fishing industry. Consequently, periods of interruption in data collection in different regions and oscillations in collection and processing efficiency were quite common. Moreover, the use of administrative records such as logbooks and fishing licenses is hampered by the lack of both, maintenance and integration of systems. Although the nationwide fishing data collection and processing system has collapsed due to lack of funding, some states, including São Paulo, Paraná and Santa Catarina, currently monitor fishing activity using specific programs designed to ensure compliance with environmental licenses of the Petrobras oil and gas activities in the Santos basin. The need for a sampling program that is economically viable and can produce nationwide basic fishery statistics is therefore paramount.

The census of fishing landing data carried out along the São Paulo coast during 2011 (Mendonça & Miranda, 2008; Ávila-da-Silva et al., 2015) was used as reference population in order to simulate a probabilistic sampling program according to the methodology proposed by the official Brazilian Institute of Statistics, the "Instituto Brasileiro de Geografia e Estatística" (IBGE) (Lima-Green & Moreira, 2012). The fishing data were obtained through the Fishing Activity Monitoring Program (PMAP), coordinated by fisheries scientists from the Fisheries Institute of the Department of Agriculture and Food Supply of São Paulo State, Brazil. The objective of this work was to evaluate the differences between the results achieved by sampling in relation to the census data collection, expecting acceptable estimates along with an important cost reduction. In each sample, the total landed catch was obtained from the Horwitz-Thompson (HT) estimator. The average estimated total among the 100 sampling simulations indicated that HT was a good estimator of the total landed catch for most municipalities, with relative low bias and high precision (Table 1). The low coverage of CI95 was attributed to the non-conformity of the Gaussian approximation used to build these intervals. The small number of possible sets of sampled ports (conglomerates) compromises the use of IC95 to evaluate the precision and the reliability of the estimates (Bussab & Morettin, 2012). Comparing the results of each of the 100 simulated samples, we found that the set of sampled ports that provided the lowest RMSE (best quality) was not the set that provided the lowest monitoring cost. Estimated catch by month, by fish categories and both (factors not considered in the sampling design) demonstrated that, as the level of required detail increased, the catch estimates became more biased and less precise. However, when compared to the 2011 true catches, the order of importance of fish categories based on estimated catches changed in some positions only after the fourth place (Figure 1A).

Table 1 - Results obtained by simple average between 100 estimates of the total catch (tons) by municipality for São Paulo coast over 2011. Y_i – True total landed catch (tons); $\hat{Y}_i$ – Estimates of total landed catch (tons); CV_i - Coefficient of variation between averages; $\%B_i$ – Bias expressed as percentage of catch 2011.

Municipality	Y_i	$\hat{Y}_i$	CV_i	$\%B_i$	*Coverage CI95*
Bertioga	216,13	216,13	0,00	0,00	
Cananéia	3289,96	3274,14	3,85	-0,48	81
Caraguatatuba	139,58	139,54	12,01	-0,03	68
Iguape	1078,18	1064,39	6,98	-1,28	77
Ilha Comprida	56,97	56,60	4,89	-0,65	100
Ilhabela	702,15	703,85	2,19	0,24	56
Itanhaém	45,47	45,47	0,00	0,00	
Mongaguá	53,94	53,88	4,96	-0,10	67
Peruíbe	147,66	147,44	3,26	-0,15	66
Praia Grande	81,00	80,37	6,04	-0,78	86
Santos/Guarujá	11423,33	11500,55	5,43	0,68	90
São Sebastião	556,93	554,27	9,20	-0,48	71
São Vicente	105,93	105,93	0,00	0,00	
Ubatuba	2064,56	2066,23	0,98	0,08	81
São Paulo State	19961,80	20008,79	3,22	0,24	

The Figure 1B presented the monthly estimated catches for four of the 20 main fish categories landed in São Paulo State, each displaying a different situation: estimates with some variability and bias (*Micropogonias furnieri*), estimates with relatively large bias (*Macrodon atricauda*), accurate estimates (*Opisthonema oglinum*), and estimates with very large variability and bias (*Cassostrea brasiliana*). The best result of monthly catches was obtained for *O. oglinum* which had very precise and unbiased estimates since the vast majority of the landings and of the landed catch occurred in ports that had been allocated into the census stratum. Estimates failed for the Oyster (*C. brasiliana*) showing the limitations of a serve-all-type stratification plan. This results also shows the importance of having good knowledge about the ports before the stratification is defined. An enormous variation in landed catch for oysters was recorded based on sampled ports, while in fact a very specific port, which almost exclusively has landings of this resource, was part of the sample. This port had been wrongly allocated into a sampled stratum rather than included into the census stratum, causing distortion and overestimation of the landed catch after being expanded over the sampled stratum.

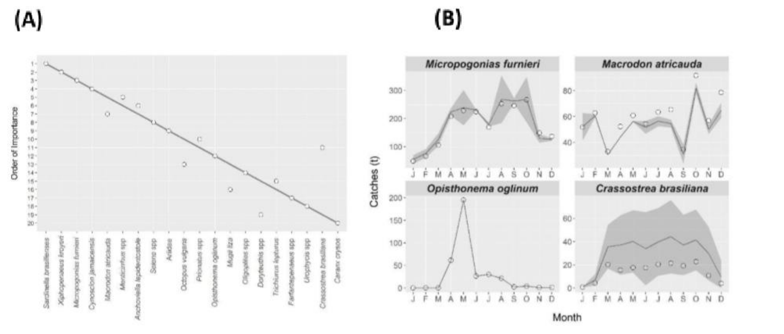

Figure 1 – **(A)** Order of importance in terms of catches of the 20 main species landed over 2011 on the São Paulo coast. Abscissa with true order for 2011 and ordinate with estimated order; matches between is a point on grey line. **(B)** True total landed catches of 2011 (open circle), estimated total landed catches (line), both in tons, and confidence interval of 95% (shaded area) by month to four of the 20 main species landed over 2011 on the São Paulo coast.

The cost reduction due to sampling was minimal in comparison with the census methodology currently in use on the São Paulo coast. This reduction was 11.2% when the set of ports of the lower RMSE sample was considered and 15.4% when the lowest cost of monitoring was taken into consideration when choosing the sample. This work demonstrated that fisheries monitoring costs are directly proportional to the required level of details and data quality. And also that the cost reduction achieved with an inferential fishing monitoring at the São Paulo coast might not compensate for the loss of accuracy in the final results, due to the high diversity of the fishing activity in this region.

The full scientific article of this work was published at the periodic Brazilian journal of Oceanography, 2016, 64(4):401-414. The continuation of this work includes the Bayesian (model-based) inference for finite populations sampling as an alternative to deal with the high diversity of fishing activity.

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Abstracts of presentations that did not provide Extended Abstracts

Use of Scottish Random Vessel Selection to Monitor Bias

James Dooley, L Clarke, A Pout, S Sweeting.

Marine Scotland Science

The Scottish scientific observer programme is nearly in its 30th year. Operated from the Marine Laboratory in Aberdeen (now part of Marine Scotland Science) it has collected discard and landings data from demersal species and crustacean species from various types of trawl fishing boats around the Scottish waters. From 2015 the monitoring scheme has also incorporated observers operated by the Scottish Fisherman's Federation (SFF).

The scheme is a stratified design with all vessels selected according to a random vessel selection forms, completed by each observer prior to the commencement of the trip. This meets a key requirement of the estimation process, allows for the correct calculation of measures of variance and the recording of non-response and refusal rates. This random element has made the sampling by observers more representative and has also had profound effect in the amount of new boats sampled. The monitoring of selection of individual observers has also led to a reduced amount of revisits to boats. The other effect of this randomisation has led to an increase in the profile of the scheme which has led to a much reduced refusal rate over the last 2 years. With further development of this programme it would be our goal to reduce future bias in the way we select vessels from fleets.

Monitoreo de flotas chilenas de cerco a través de observadores científicos y bitácoras de autorreporte: Implicancia del origen del dato en las estimaciones de captura y descarte

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Se cumplen tres años desde el inicio del Programa de investigación del descarte y captura incidental en flotas de cerco que operan en la zona centro-sur de Chile. Se analizaron los resultados y se hicieron recomendaciones para la confección de un plan de mitigación.

Las flotas en estudio correspondieron a una industrial, constituida por 34 naves mayores que orientaron sus actividades sobre jurel (Trachurus murphyi) y/o a la pesquería multiespecífica de sardina común (Strangomera bentincki) y anchoveta (Engraulis ringens), pudiendo pescar en zonas oceánicas (jurel) y costeras desde 32°10’ LS hasta 43°44’LS. La flota artesanal (semi- industrial) con más de 500 embarcaciones, sólo operó sobre sardina común y anchoveta, en zonas costeras cercanas a sus puertos de recalada. La obtención de información fue realizada a través de dos fuentes: (1) datos recopilados a bordo a través de observadores científicos y (2) datos obtenidos directamente de los pescadores mediante una bitácora de autorreporte, con información de cada lance y viaje de pesca.

Los resultados mostraron un patrón diferenciado en las estimaciones de captura total y descarte, dependiendo del origen del dato. En las estimaciones de captura total, no se observaron diferencias significativas en los estratos año y región, tanto en la flota artesanal como en la flota industrial de sardina común y anchoveta. Sólo se observaron discrepancias en la flota industrial que operó sobre jurel, con diferencias principalmente en 2016 y 2017. En cuanto a las estimaciones de captura descartada según el origen de la información, siempre se observó una mayor estimación de captura descartada con los datos de observadores científicos, destacándose la magnitud de esta diferencia en la flota industrial de jurel,

la que alcanzó en 2017 entre 1,1% y 16,7%, con datos de autorreporte y observadores respectivamente.

Las diferencias observadas en las estimaciones de descarte desde las dos fuentes, pueden ser explicadas principalmente por la desconfianza de los pescadores en el uso de esta información, ya que el descarte estuvo prohibido y penalizado históricamente hasta la implementación del programa de investigación. Estimaciones de captura y mortalidad incidental, sólo pudieron ser realizadas con datos de observadores científicos, mientras que otros indicadores biológicos como riqueza de especies fueron mejor representados por datos entregados por los pescadores. Se destaca la complementariedad de la información desde las dos fuentes, sobre todo al momento considerar toda la información disponible para plantear las medidas de mitigación.

Estimación de la Pérdida de Fluidos de anchoveta desde su Captura hasta su Desembarque a bordo de Embarcaciones Pesqueras del litoral peruano

Manuel Ochoa Madrid, Pablo Marín, Marilú Bouchon, Julio Limache, Gersson Roman, Cecilia Peña

Instituto del Mar del Perú (IMARPE)

En una pesquería pueden existir importantes diferencias entre las cantidades en peso que son capturadas y las que son registradas oficialmente en las estadísticas (desembarque). Estas diferencias, pueden deberse entre otros a la pérdida de fluidos que pueden sesgar de manera significativa la evaluación del stock y las medidas de manejo derivadas de ella. Estos fluidos, conocidos como sanguaza, son generados por efectos de manipulación o almacenamiento (la presión, temperatura del ambiente, la degradación de enzimas o proteínas, entre otros). La cantidad de líquidos que se pierde durante las actividades de pesca, depende de la distancia del área de pesca al lugar de desembarque y de los volúmenes de captura. Este último, a mayores capturas se genera una mayor presión sobre las capas inferiores de la bodega ocasionando una mayor pérdida de líquidos.

En el Perú la pesquería industrial de anchoveta tiene un rol importante en el desempeño del sector pesquero en general, por este motivo, en los últimos años se viene realizado especial esfuerzo en la investigación de datos no cuantificadas necesarios para la formulación de políticas pesquera.

Con el objetivo de estimar la perdida de fluidos en la pesquería industrial de anchoveta en el litoral peruano, se realizó el análisis de la información de las capturas reales obtenidas a bordo de embarcaciones pesqueras mediante el Programa Bitácoras de pesca y las del desembarque oficial atreves del Seguimiento de la Pesquería Pelágica de Instituto del Mar de Perú, caracterizándolas por tipo de flota (embarcaciones de acero y de madera) y a través del tiempo, para el periodo 1996 – 2016. Observándose que durante la época de la carrera olímpica (2005-2008), la pérdida de fluidos presentó un importante nivel de variabilidad hasta aproximadamente 12% en las embarcaciones de acero y cerca al 10% en las de madera, esto debido a que el exceso de flota pesquera obligaba a pescar más en el menor tiempo posible lo que ocasionó que llegara demasiada pesca a las fábricas con demoras de más de un día en la descarga y aún más en el procesamiento, produciendo pérdidas de mayor cantidad de líquidos.

Con la introducción de las cuotas individuales IVQ en la pesquería industrial de anchoveta, se incrementaron las temporadas de pesca y disminuyeron considerablemente el número de embarcaciones, realizándose las descargas en menor tiempo con menor pérdida de fluidos.

Session 6 - Harmonizing and standardizing monitoring programs

Leader: Elizabeth Chilton

The harmonization and standardization of at-sea monitoring programs are key for maximizing data quality, particularly if the data from these programmes are shared and pooled between countries, regions and stocks. Examples of this are the disparate at-sea monitoring programmes in the U.S. and EU and their common data uses. Co-ordinated approaches reflect the diverse needs of regional/national observer programs while achieving consistency in key areas of importance, such as funding, safety, health and data quality. This session reviewed and identified the best practices adopted in national and regional programs and explored various approaches for coordinating observer programs.

Oral Presentations - Extended Abstracts

A review of the harmonised standards between Tuna RFMO Transhipment Observer Programmes.

Steven Young

MRAG Ltd

In light of concerns that transhipments on the High Seas may be used in tuna laundering operations, a series of programmes to place observers on vessels which tranship with tuna longliners were established by RFMOs – by ICCAT (International Commission for the Conservation of Atlantic Tunas) in 2007 and by IOTC (Indian Ocean Tuna Commission) and IATTC (Inter-American Tropical Tuna Commission) in 2009. The ICCAT and IOTC observer programmes have been managed by a consortium between MRAG Ltd and CapFish since inception, and the IATTC programme is managed by MRAG Americas.

The scope of these programmes is geographical, with ICCAT, IOTC and IATTC covering the Atlantic, Indian and eastern Pacific respectively. In addition, observers have also worked under the remit of CCSBT (Commission for the Conservation of Southern Bluefin Tuna) since its establishment in 2010. In contrast with the RFMOs, the scope of this programme is species-specific. As the geographical range of Southern Bluefin tuna falls within all three oceans, observers across all programmes are able to act as CCSBT and RFMO observers simultaneously.

Due to the similarities across programmes in terms of working conditions and programme objectives, the observer's role and working practices are also very similar. Observer roles include:

- Monitoring transhipment of products
- Product Counts
- Weight estimates

- Species verification
- Verifying transhipment details
- Location
- Vessels involved
- Countersign transhipment document
- Fishing vessel inspections
- Confirm vessel markings are correct
- Check presence of Vessel Monitoring System (VMS)
- Check vessel possesses a compliant fishing logbook
- Check vessel possesses a compliant fishing licence

This enables many opportunities for harmonising the management and implementation of these programmes. The similarities in role enable observers to be cross-trained as ICCAT, IOTC and CCSBT observers simultaneously, with training in practical aspects of the job such as pre-sea safety inspections of carrier vessels, monitoring transhipments, conducting fishing vessel inspections and health & safety (both general and transhipment-specific) being almost identical. Background information, for example on the role of observers and the RFMOs in combating IUU, also introduces concepts common to both transhipment programmes.

Topics covered by the training course include:

- IOTC and ICCAT
- Informs observers about the organisation, role and responsibilities of these two RFMOs
- Regional Observer Programmes
- Introduces observers to the framework of the Regional Observer Programmes
- Tuna Biology
- Review of the biology and catches of significant tuna and tuna-like species
- Longline fisheries and transhipment operations
- Review of the vessel types and operational procedures
- Conservation and Management Measures
- Review of IOTC Resolutions and ICCAT Recommendations relevant to transhipment operations
- Observer Code of Conduct and the Memorandum of Understanding
- Describes the reciprocal rights and responsibilities of observers, operators and observer suppliers
- Health & Safety
- General review of health & safety, plus transhipment-specific issues and conflict resolution
- Transhipments and IUU

- Introduction to general and transhipment-specific IUU issues
- Deployment Cycle
- Review of transhipment deployment processes, from initial notification of deployment to debriefing and report submission
- Tuna, bycatch and product identification
- Identification of transhipped products, practice of fish counts using videos of real transfers, and training in the specific requirements for CCSBT
- Fishing vessel and compliance reporting
- Full inspection procedures for both IOTC and ICCAT
- Data Recording
- Data recording on data forms and database, generation of the final report and handling and labelling of photos
- Language and cultural awareness
- Training in the Japanese language and general cultural issues
- Administration and finance
- Invoicing and contracts
- Final Exam

Programme implementation is also harmonised across programmes. IOTC and ICCAT notify deployment requests in a similar fashion and many vessels operate in both the Atlantic and Indian Oceans, facilitating liaison with operators and agents common to both. This also enables crossover deployments in which observers remain on vessels whilst moving from one ocean to the other, leading to greater efficiency in logistical planning and flights. For example, during 2016, twelve out of 70 IOTC deployments (17%) were crossovers either to or from ICCAT.

Reporting requirements are standardised, with both IOTC and ICCAT receiving reports every five days summarising transhipments observed. These were formerly emailed to the clients, although more recently an online submission system has been introduced to which outputs are uploaded, and then downloaded by the client. The final report is also produced to a common template. Data is recorded in a database from which deployment outputs can be exported. Database design is very similar for both programmes because the data required for each is so similar.

In summary, there is a great deal of harmonisation in all aspects of the IOTC, ICCAT and CCSBT observer programmes, which can lead to greater efficiency in management and implementation.

Implementation of regional and pan regional fisheries data collection programmes by the countries within the European Union – challenges and opportunities

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The European Commission and the EU Member States Council of Ministers for Fisheries agreed in 2001 on establishing a Community programme for the collection of data in the fisheries sector that was implemented from 2002.

In 2002 the EU had 15 Member States (28 MS from 2014) and several Member States (MS) are having several regional fisheries research laboratories. Many data collection operators are therefore involved. All laboratories have several decades of deeply-rooted data collection practices. Among the operators these practices may not be comparable.

Within the International Council of the Exploration of the Sea (ICES) a number of survey (fishery independent data collection) planning groups, with the tasks of establishing coordination, standardisation and quality ensurance procedures, have been running for years.

For fishery dependent data collection no common standards were described nor implemented when the EU data collection regulation came into force. All the coastal EU MS have for decades have been collecting fisheries data and most MS had their own approach. There was no provisions in the 2002 data collection regulation obliging MS to coordinate and standardise their data collection.

The ICES community which provides scientific advice on fish stock status and fishing opportunities for the North East Atlantic Region recognised, that without cooperation among the MS the quality of the data from commercial catches sampling would decrease. Thereby degrade the quality of the input data for the stock assessment analysis. Therefore, ICES found it necessary to establish a coordination forum and to seek to achieve some standardisation of collection of fisheries data.

As a consequence of these needs the ICES Planning Group on Commercial Catches, Discards and Biological Sampling (PGCCDBS) was established in 2002. This planning groups should implement the ICES Quality Assurance Framework to ensure that data sets and parameters supporting assessments and advice for the ICES area are based on i) statistically-sound sampling schemes; ii) correct and consistent interpretation of biological material such as otoliths and gonads; iii) technology that improves accuracy and cost-effectiveness of data collection; iv) comprehensive and easily sourced documentation, and v) efficient collaboration between PGCCDBS, ICES expert groups and other bodies in relation to data collection.

The outputs of the series of PGCCDBS meetings and associated intersessional work such as workshops and exchanges formed an extremely valuable resource summarising current state of knowledge in Europe and worldwide. In many cases, a high degree of technical and scientific competence has been required for PGCCDBS workshops (such as sampling design and data analysis), and leading experts from Europe and overseas have been involved.

The PGCCDBS focused on work completed since the last year, planned work for the current and next year, in the following topics which have formed the basis of the Terms of Reference:

- Stock-based biological parameters from sampling of fishery and survey catches (age, growth, maturity, fecundity, sex ratio)
- Fleet/métier related variables (discards estimates and length/age compositions of landings and discards) and statistical design of sampling schemes
- Data collection technology (hardware, and software such as WebGR and the Regional Data bases).
- Implementation of the ICES Quality Assurance Framework
- Addressing recommendations and requests for advice from ICES expert groups (including through PGCCDBS data contact persons), and RCMs.

The EU MS around the Mediterranean decided to establish an equivalent to the PGCCDBS the Planning Group for the Mediterranean (PGMED). The PGCCDBS met annually with PGMED for a joined meeting for two day and had parallel meetings for three days.

Therefore, within the ICES community substantial effort and many workshops and expert groups with the aims of improving fisheries data collection have been conducted. Knowledge on how to run data collection programmes have been gained and common approached on statistical sound sampling schemes have been or are to be implement by some MSs.

Since 2002 a large number of guidelines and manuals such as sampling manuals, age readings and maturity staging manuals have been made. In addition to this production sampling Methods Workshops (26 since 2002), Age calibration workshops and otolith exchange programmes (75 since 2002) and Maturity staging workshop (14 since 2002) have been conducted.

PGCCDBS related reports can be found at: www.ices.dk/community/Pages/PGCCDBS-doc-repository.aspx

In addition to the effort on standardisation a regional/pan-regional data base holding fishery dependent data was developed by DTU Aqua and handed it over to ICES in 2011.

In the process of developing common data collection standards it was also realised that significant cooperation and coordination within each sea basin region and on pan-European level was needed. It was recognised that if common sampling design standards are implemented within a region possibilities of using other MS data are increased and a much more cost effective sampling programme can be implemented. The EU Commission followed the effort carried out in ICES and by the MS. The EU Commission and the MS's agreed in 2004 to set up Regional Coordination Meetings (RCM) though without no legal basis. On the basis of work in ICES and the RCM's provisions on regional cooperation and coordination in the revision of the regulation data collection regulation adopted in 2009 and further extended in the recast of the regulation in 2017.

The present DCF adopted in 2017 includes provisions obliging MS to coordinate their data collection activities with other MS in the same marine region and to make every effort to coordinate their actions with third countries having sovereignty or jurisdiction over waters in the same marine region. To facilitate this regional coordination, Regional Coordination Groups (RCG) are established by the relevant MS for each marine region. The RCG's are having the aim at developing and implementing procedures, methods, quality assurance and quality control for collecting and processing data with a view to enabling the reliability of scientific advice to be further improved. In addition, regional coordination groups shall aim to develop and implement regional databases.

The RCG's have decision power but work on the basis of consensus.

Lessons learned

When carrying out commercial fisheries data collection in a sea basin and where a large number of operators are involved, significant effort in standardisation and coordination of the data collection is needed.

When starting the process of standardisation and coordination one should not take anything for granted - not even simple things. Not even how to measure a fish. Is it total length or fork length?

Further, remember the three T's. "Things Take Time". Especially when a large number of countries or operators are involved. To change habits takes long time – it takes years. There is a need for running and repeating age determination workshops and/or otolith exchange programmes in order continually to check consistency among the readers. Ensuring a constant focus on improving statistical based sampling schemes.

Finally, a well working regional or multi-regional database and estimation system is a prerequisite.

A Plane Approach: Developing Electronic Monitoring in the United States

Brett Alger

NOAA Fisheries, USA

Commercial fisheries increasingly are incorporating electronic monitoring (EM) into existing fishery-dependent data collection programs. Seven fisheries across the United States are using EM for catch accounting and/or compliance with catch retention requirements, including fisheries in the Northeast (Atlantic herring and mackerel, and groundfish), West Coast (Groundfish, Pacific whiting), Alaska (fixed gear groundfish and Pacific halibut), and Highly Migratory Species (HMS; Atlantic Bluefin tuna). As these programs mature, and additional fisheries consider EM for their own data collection and monitoring, it is imperative that programs coordinate and make efficient use from the lessons learned to support emerging EM programs. Moreover, in order to promote innovation and competition among EM service providers, managers must provide a shared set of standards and policies, while balancing regional heterogeneity and concerns from local constituents.

NOAA Fisheries has made deliberate efforts to support the implementation of electronic technologies in fishery-dependent data collection. In 2014, a national electronic technologies working group (ETWG) was established to share information and coordinate internal NOAA Fisheries expertise and ongoing work related to electronic technology development, implementation, and operational issues. The ETWG provides a coordinated approach for addressing day-to-day requests, long range planning, budgeting, policy development, and challenges that impede progress related to EM. The ETWG will be addressing issues relevant to EM programs around the world, including but not limited to:

- EM program cost allocation
- Video storage and retention requirements
- Hardware and software
- Video review and automation
- Data collected from the imagery
- EM service provider approval process and auditing providers
- Imagery access and ownership
- Imagery and data transmission
- Writing statements of work

The ETWG expects to find commonalities and differences across the EM programs in the United States in these categories, yet, will strive to develop best practices, minimum requirements, and/or national standards, while balancing unique fisheries and data requirements across regions. NOAA Fisheries plans to have policies developed for several of these categories by the end of 2018. We look forward to working across the regions and countries to move EM forward.

Electronic Monitoring - From Imagery to Data: Establishing Data Analysis Process Standards in the Western and Central Pacific Tuna Fishery

Malo Hosken

Pacific Community (SPC)

There are over 600 longline and 257 purse seine vessels registered to operate in the Exclusive Economic Zones of the 22 Pacific Islands Countries and Territories (PICTs). While the Western and Central Pacific Fisheries Commission (WCPFC) requires 100% observer coverage of the purse seine fleet, only 5% observer coverage is required for the longline fleet and this target has proven difficult to reach due to a range of reasons.

In an effort to address this gap, PICTs, regional and sub-regional fishery management organisations, non-government organisations and electronic monitoring service providers have been collaborating since 2014 on the implementation of electronic monitoring (EM) technology on tuna longline vessels. While some countries have taken the approach of using EM as a complimentary tool to existing observer programmes, others have considered using EM as stand-alone tool when it is either unsafe or unpractical to place observers on longline vessels they licence to operate in their zones.

In 2014, recognising the need for PICTs to implement EM as well as the need to establish documented policies and standards for this technology, the WCPFC established the Electronic Reporting and Electronic Monitoring Working Group. This specialised working group has since met once in 2015 and again in 2016.

Recognising the need for process standards for the provision of longline operational observer data fields collected through EM systems, SPC facilitated a first regional EM Process Standards workshop in 2016[10]. This workshop focused on the detailed data standards for EM by defining the scientific data fields and describing the business requirements in relation to those data fields.

In 2017, a second regional EM process standards workshop held at SPC provided (i) revised draft EM longline process standards (ii) draft EM purse seine process standards and (iii) draft EM transhipment and unloading process standards. The purpose of establishing the process standards for EM is to provide guidance on how the agreed standard observer data fields[11] can be collected (or not) using EM. Both workshops focussed on the full range of Data Collection Committee (DCC) standards12 which SPC and FFA members utilise.

This harmonisation approach with existing observer operational data field ensures continuity with the current observer data needs. In the future, this approach will allow having EM programmes established in hand with existing observer programmes and for observers to focus on collecting greater biological information and tissue samples.

It is intended that through a variety of fora these drafts standards be refined and made available to PICTs and EM service providers and to the WCPFC ER Reporting and EM Working Group for its consideration.

Since the first trial of EM on two longline vessels in the Solomon Islands in 2014, there are today 68 longline vessel, two purse seine vessels and one carrier vessel equipped with EM operating in PICTs zones. Having regionally agreed EM data process standards is a key step towards the efficient implementation of EM technology in the WCPO.

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10 https://www.wcpfc.int/node/27441

11 The Data Collection Committee (DCC) standards which FFA/SPC members utilise and the WCPFC Regional Observer Programme (ROP) minimum data field standards which are mandatory for WCPFC members.

12 http://oceanfish.spc.int/en/meetingsworkshops/dcc/444-10th-tuna-fishery-data-collection-committee-12-15th-dec-2016

Harmonized monitoring in a disaggregated fishery

Timothy Park

Pacific Community (SPC), Fisheries, Aquaculture and Marine Ecosystems

The Western and Central Pacific Ocean (WCPO) holds the world's largest tuna fishery with its waters producing ~2,700,000 mt, or ~56% of the global tuna catch. The tuna fishery is composed of three industrial gear-types: purse seine (15 fleets, 257 vessels), longline (23 flagged fleets, 666 vessels), and pole and line (25 vessels). With other carrier and bunker vessels, about 1100 vessels are on the regional register of fishing vessels in the WCPO. The value of the fishery is USD5.3 billion, which provides almost USD500 million in access fees from foreign fishing vessels to fish in the waters of the small Pacific Island Countries and Territories (PICTs). The value of IUU fishing is currently estimated to be as high as USD616 million, and this drives the compliance monitoring initiatives in the WCPO. The overarching Regional Fisheries Management Organisation (RFMO) is the Western and Central Pacific Fisheries Commission (WCPFC, 26 members, 7 participating states), though other regional organisations provide support to the PICTs. The Pacific Community (SPC, 26 members) is the science and technical service provider and regional data manager, and the Pacific Islands Forum Fisheries Agency (FFA, 17 members) supports regional coordination of initiatives in fisheries compliance, management and sustainable development. The sub-regional organization the Parties to the Nauru Agreement (PNA, 8 members), works to maximize financial benefit from PICTs from tuna fisheries.

SPC, FFA and PNA provide the support to harmonise the geographically disaggregated PICTs national and subregional observer programmes. Harmonisation has been achieved through developing homogeneous training standards, which are recognized as a benchmark qualification for authorisation as providers under the WCPFC Regional Observer Programme (ROP). Regional data collection standards were established and maintained through the formation of a regional SPC/FFA Data Collection Committee (DCC). The observer data collected are stored in a central data warehouse that integrates data from different sources (Tufman2). Coordination and cooperation among national and subregional observer programmes is promoted through an annual observer programme coordinators' meeting (ROCW). These common features have allowed a federation of PICTs programmes under a united label, the Pacific Island Regional Fisheries Observer (PIRFO) 'brand' that is commonly owned by all the PICTs observer programmes.

Observers are an important monitoring tool used to collect independent operational data supporting fisheries management in the WCPO. However, since 2008, the role of fisheries observers has shifted from that of independent catch verification and scientific sampling to that where their role includes monitoring the implementation of, and compliance with, WCPFC conservation management measures (CMMs). In particular, one CMM that requires catch retention of target species and a FAD closure period for purse seiners, and verification of longline catches to meet flag-state-based catch limits for bigeye and yellowfin, specifies that observers monitor vessels' compliance with the measure. This measure stipulates 100% observer coverage of purse seine effort (~2,000 observer trips p.a.), 5% of longline effort (~700 observer trips p.a.) and coverage of all high seas transhipments (~550 transhipments p.a.). The 15 observer programmes of PICTs provide the majority of observer services for flag-states to meet these requirements. PICTs programmes expanded rapidly to benefit from the revenue and employment generated as observer service providers and there are now more than 800 active observers under PIRFO, providing significant revenue at the village level. Observing is a significant employer in many PICTs and national and regional cost recovery initiatives have created more of a business culture with national programmes operating as observer service providers to foreign fleets.

The key challenges with respect to observer programmes in the region are the increasing use of observers to monitor vessels' compliance with CMMs and the difficulty of achieving sufficient coverage for the longline fishery.

The amount of data observers collect for compliance monitoring has increased with an increase in the number of CMMs pertaining to observer duties (14), since the advent of the ROP in 2007. There has been a corresponding decline in the number of biological samples collected by observers in the past three years. Observer coordinators have stated that this is due to observers having reached their limit of capacity to collect data owing to the competing roles of an observer to monitor compliance and collect scientific data and samples.

The existing 5% observer coverage level has been shown to be too low for robust species composition estimates for even target species in the tropical and subtropical longline fisheries. (Lawson, 2004, 2005). Reliability estimates suggest an increase in coverage from 5% by a factor of 2-4 times for target species and much more for bycatch species, if the coverage was evenly stratified. Unstratified coverage requires an even higher level of coverage.

To improve coverage across all fleets the WCPO longline fishery has been stratified into 29 'fisheries' by flag and area of operation. Flag-states must ensure 5% coverage across each of these 'fisheries' and report the coverage to the WCPFC.

However in 2016, of the 29 fisheries, 17 met the 5% minimum coverage requirements, five had 'insufficient (<5%) coverage and five had no coverage, two pairs of fisheries had also been combined in the flag state reporting (Williams, et al, 2017). Some of the largest (highest effort) of these 'fisheries' had 'insufficient' coverage. Some of these operated and transshipped solely on the high seas, not returning to their homeport for up to 18 months and so were difficult to monitor using observers.

Thus, there is a critical need to increase the level of monitoring coverage, more evenly stratifying coverage across all 'fisheries' and reducing the reliance on observers to collect all operational data, especially that pertaining to compliance.

The dispersed and inaccessible nature of some of these 'fisheries' to observer deployment suggests alternative systems be examined to supplement the data currently collected. A complimentary monitoring strategy, integrating different methods, and creating scalable monitoring systems to provide the necessary coverage for all needs is required.

Electronic-Monitoring (EM) is now being implemented in the WCPO longline fishery. Current initiatives are to standardise regionally data formats, data management and security, verification and validation processes, and to improve observer safety. However, there remains a perception of EM as an alternative to observers. The current challenge in the region is to integrate these as distinct but complimentary tools and utilise the strengths of each monitoring system to cross validate data quality for science, compliance and management. Defining each system's data standards and protocols has been the first step toward an integrated at-sea monitoring system.

A recent WCPO regional EM standards workshop recommended that observers and EM systems need to be implemented and coexist as cross-validating tools and as scalable systems to provide adequate coverage (Anon. 2017).

This year's PIRFO Regional Observer Coordinators Workshop (ROCW18) articulated the concerns of PICTs observer programmes with respect to the implementation of alternative monitoring tools. ROCW18 recommended:

- an integration of monitoring tools is supported by an investigation of appropriate coverage levels for all data fields and is based on paired trip trials as to the effectiveness of all tools to collect each field;
- to conduct a data needs analysis to specify what data fields are collected by each monitoring tool and how those tools can be used in a complementary manner;
- to prescribe minimum coverage levels for each tool separately to avoid industry perception of a choice of alternative tools available; and
- that the impact of new technologies on observers and observer training be assessed.

This paper relates to WCPO fisheries data collection issues, opportunities and considerations in integrating observer and electronic monitoring systems to meet the needs of small PICTs. There is a difference in the rationale behind implementation of monitoring tools in the Pacific Islands. While a developed country's considerations in choosing monitoring systems will tend to focus on efficiency and cost effectiveness, the developing PICTs' consider the opportunities for vocational skilling, employment and long-term economic security from its principal resources as priorities.

Limited capacity and resources in PICTs precludes adopting large nationally managed monitoring systems. Rather an integration of technologies, nationally and regionally supported, to build coverage to statistically robust or compliance-sufficient levels is more sustainable.

Integrated systems do require clearly defined processes for quality assurance. Quality assurance processes includes verification (debriefing or data accuracy checking) and validation (independent cross-referencing) processes to use the strengths of all tools to improve the accuracy of the data overall.

Finally, with adoption of new electronic technologies among PICTs there has been a temptation to automate collection of data for efficiency. However, it is important to consider the purpose of each data field collected when considering automation versus manual collection, as there may be value in fields with apparent innate redundancy, such as to verify or validate other data fields.

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Open Discussion Session

Q- - How did you get everyone to have standards and shared. Technical and cultural side. Sustainable Development Goals – were they thought of?
A - In the 1990's in Denmark, we took a lot of time to develop. At ICES in 2011, countries agreed over time to join the database. Logbooks were aggregated statistics by métier, just used for coordination of vessels and we developed agreements for data confidentiality. By relying on each other, we ensure that no data on individual level can tamper with data.

Q - On the topic of integration of technology into sampling methodologies, how do you bring harmony to programs across different regions?
A - The focus is based on data product, the final output from the equipment technologies. Suggest that you don't try to specify the exact piece of equipment to allow room for innovativeness rather than be too prescriptive. Think of the data needs outside of an individual program to provide harmony and data equitability.

Q - There has been a dramatic change in safety equipment on vessels, along with human right violations and maintaining safety standards.
A - Safety equipment, Emergency Action Plan requirement, 2-way communication device are key. 2-way communication device on RFMO transshipment, have two uses 1) reporting an emergency and 2) an independent means of communication. PLB's are also being provided. Observers have the right to refuse if they feel they shouldn't deploy on a vessel. MOUs with operators that are signed and returned by vessels and used in international fisheries. If there is a problem on the vessel with overloading the number of crew, the international observer program can liaise directly with the vessel and disembark crew.

Q - How are we sharing the lessons learned from the innovation with electronic monitoring to prevent much harmonization after the the data has been collected?
A - The US is using small pilot programs and other equipment deployments, all in different states of of development along the timeline. Sharing best practices can help inform the new, upcoming programs so collectively we are not recreating the wheel. Agree that it takes time to develop a new technology, sometimes you need a new generation to come in and acknowledge that everyone (vessel crew, data collectors, and data users) has to adjust to the changes. It's also a good idea to replicate the best examples when applicable, EM will be part of the observer scheme.

Q - Indian Ocean Community – Artisanal fleet – observer coverage 0%. Srilanka – gillnet. Standards for coastal fleets?
A - We do have separate standards for inshore small and large.

Q - More data harmonizing sounds good. From political view, the ability of government involvement can either help or hinder this effort.
A - In the Indian Ocean, countries with similar subsistence fishing programs tend to work better together. Differing geopolitical views will make the outcome different, such as 4 to 5 different coordinated programs can make things complicated, take you down different roads of program development. Suggest forming a block of countries with similar goals, as the process for buy in helps.

Q - What about the future need for observer employment, with the belief that it's cheaper to have EM. That's not true in all parts of the world.
A - Creating a cost benefits analysis in your program, observers may be a lot less per hour of data collected. For instance in the 100% in purse seine fishery, EM created employment opportunities that was not just about monitoring but also video review and equipment technicians. Shifting a skillset from an observer onboard to curating the data, deployed observers are not a risk and there may be more jobs with EM. Experienced observers are needed to watch video. EM will never replace humans; for the collection of biological samples.

Q - How do you evaluate the fisheries assessment and make sure that observer data is used in the assessment?
A - Not all stock analysts can access fishery databases and that is a challenge. We seem to be on the right track, perhaps another 3-4 years to get there.

Q - There are different goals in observer programs, what is common across all these programs to improve conditions for our people at sea?
A - We need to focus on the cooperative nature of our programs with industry and data users. The technical needs seem to be easier to resolve than the political issues. National legislation should be greatly improved, sending a message about support from government leaders. Fairly recently, we have improved insurance standards for observers. NAFO has done a lot with standardization of data collection, can be found on the NAFO website. Suggest that vessel inspections and enforcement become more efficient.

Poster Presentations – Extended Abstracts

Improvements in U.S. Fish Bycatch Data Quality: Tier Classification System Results for 2005 vs. 2015

Lee Benaka, Noelle Olsen, and Young-Woo Lee

NOAA Fisheries, Office of Science and Technology, Silver Spring, Maryland, USA

Bycatch occurs when fishing methods are not sufficiently selective for target species, or when take of protected species occurs as a result of fishing. Total fishing mortality can be estimated only through methods to account for the magnitude of bycatch. NOAA Fisheries documents bycatch levels in U.S. fisheries through the publication of national bycatch reports. A tier classification system evaluates the quality of bycatch data and the reliability of estimation methods to develop bycatch estimates for selected U.S. commercial fisheries. NOAA Fisheries experts conducted this analysis in 2005 for 142 fisheries and in 2015 for 126 fisheries. The tier classification system defines its tiers as follows:

- Tier 4—Bycatch estimates are based on observer program data collected on an annual basis for at least the past five years, with partial or complete sampling frames and negligible or nonexistent program design deficiencies.
- Tier 3—Observer program data were collected over the past five years, although not necessarily on an annual basis, and sampling frames were either partial or incomplete.
- Tier 2—Bycatch estimates typically were based on somewhat inconsistent or unreliable information (e.g., self-reported logbooks), but current or recent observer data may have been available for some of these fisheries.
- Tier 1—Observer data were not available or have not been collected during the past 10 years, or serious deficiencies or limitations in the design of the observer program were identified.
- Tier 0—Bycatch data collection programs have not been implemented.

Tier Classification System scoring criteria break down into the following categories:

- Bycatch data adequacy criteria
- Length of observer program (5 points)
- Sampling frame (3 points)
- Sampling design (12 points)
- Design implementation (8 points)
- Data quality control (5 points)
- Industry bycatch data (2 points)
- Supplemental data (10 points)
- Database/information technology considerations (2 points)

- Bycatch estimate quality criteria
- Assumptions identified, tested, and appropriate (10 points)
- Peer-reviewed/published (8 points)
- Statistical bias of estimators (4 points)
- Measures of uncertainty (3 points)

Fisheries that received a score of 0 were classified as Tier 0. Fisheries that received a score of 1 to 31 were classified as Tier 1. Fisheries that received a score of 32 to 48 were classified as Tier 2. Fisheries that received a score of 49 to 65 were classified as Tier 3, and fisheries with scores of 66 to 72 were classified as Tier 4.

Although all tier percentages changed between 2005 and 2015, the greatest changes were in Tier 0 and Tier 4 fisheries. The percentage of Tier 0 fisheries decreased, and the percentage of Tier 4 fisheries increased, from 2005 to 2015 (see Figures 1 and 2). The percentage of Tier 0 fisheries decreased mostly due to new pilot observer programs, and the percentage of Tier 4 fisheries increased mostly due to the restructuring of the Alaska Observer Program, which among other things addressed sources of bias related to observer coverage and expanded the number and types of vessels with observer coverage.

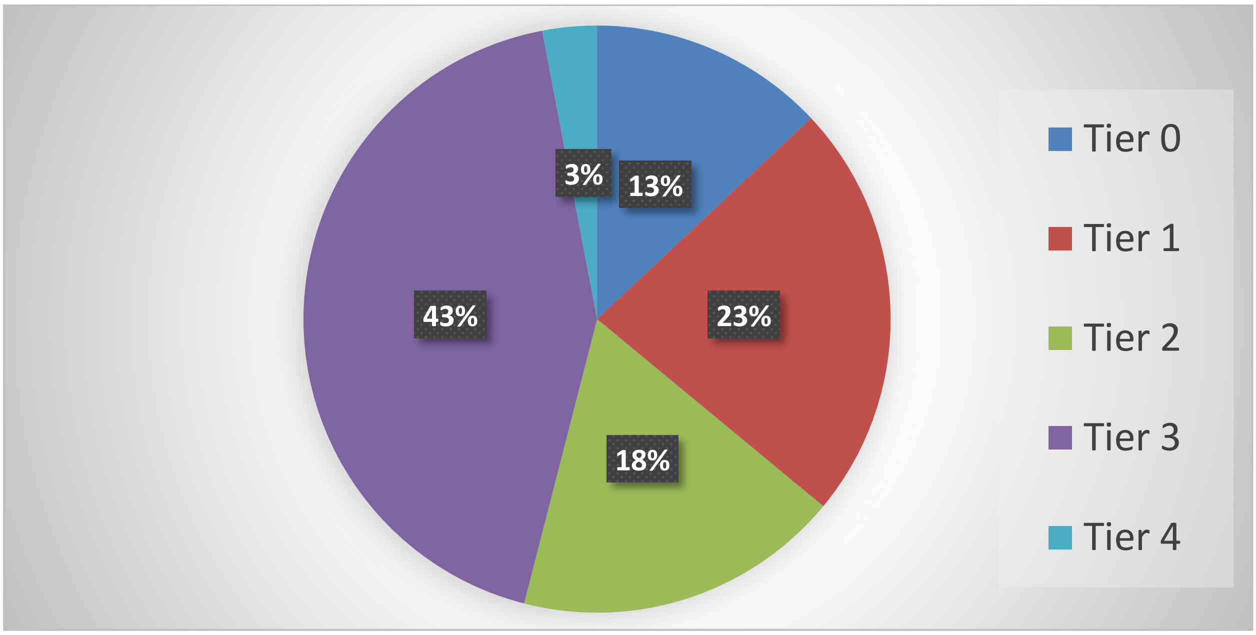

Figure 1. Tier classification scores for fish bycatch data quality in 2005 (number of fisheries evaluated = 142)

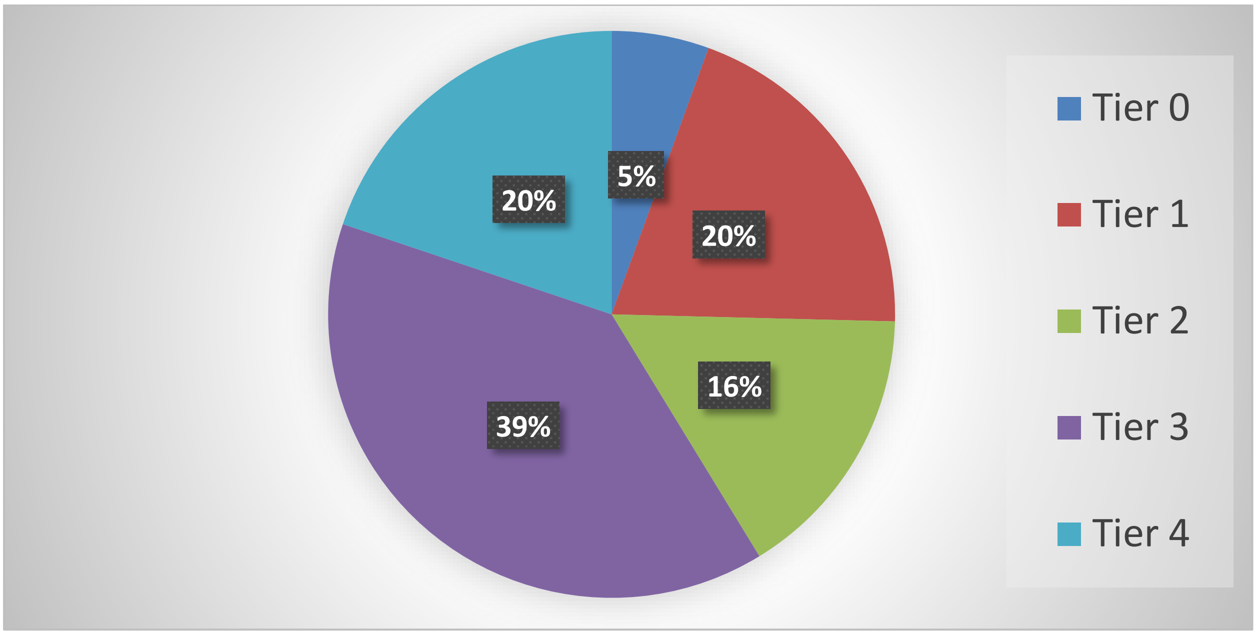

Figure 2. Tier classification scores for fish bycatch data quality in 2015 (number of fisheries evaluated = 126)

Among the evaluated fisheries that demonstrated improved Tier Classification Scores, the Gulf of Mexico shrimp trawl fishery moved from Tier 2 to Tier 3 due to improved scores in the areas of sampling design, design implementation, and data quality control. The Bering Sea/Aleutian Islands pollock trawl fishery moved from Tier 3 to Tier 4 due to improved scores in sampling frame and sampling design.

Abstracts of presentations that did not provide Extended Abstracts

Harmonizing and standardizing at-sea monitoring programs in the South West Indian Ocean: a challenge at regional scale

Teresa Athayde

SeaMOre - Individual Consultant

The geographical configuration of the SWIO region, where coastal states EEZ limits merge together, all around Madagascar, obliges SWIO countries to coordinate Observers' deployments with the industrial tuna fleets operating in their waters, to maximize Observer coverage. To exchange Observer data and maximize data quality National Observer Programmes (NOPs) need to harmonize and standardize data collection. Yet, such co-ordinated approach demands a high level of political willingness and technical capacity both at national and regional level. An agreement signed in 2010 by the Indian Ocean Commission (IOC) member states, for the certification of state observers at IOC level, proved member states political willingness to co- ordinated such activities.

Since 2015 two studies where undertook, under the aegis of the IOC, to identify and overcome difficulties in harmonising and standardizing Fisheries Observers Monitoring Programs in the SWIO. Key barriers to harmonisation included: 1) A high disparity among NOPs Observer minimum recruitment requirements, Observer management, data verification and reliability; 2) a lack of regional standards for the training and management of observers, and 3) a lack of standard tools for the collection, verification, sharing and dissemination of observer data. Furthermore the existence of multiple observer initiatives targeting the industrial tuna fleet provoked great confusion among NOPs who see their Observers trained by multiple organisation in the usage of different data collection and storing tools.

The absence of harmonisation concerning Observer recruitment, training and management requirements and the lack of standard data collection tools has proven to impede the usage of state observers at sub-regional level and the fair exchange/sharing of observer data among countries. The lack of coordination among organisations/programs sponsoring Observer initiatives is hampering observer management, increasing observer work load and hindering efforts towards the harmonisation and standardisation of at-sea monitoring programs, key for maximizing data quality. Furthermore the lack of coordination among different initiatives is conducting to a duplication of efforts and delaying the achievement of initiatives objectives.

Recommendations where provided to harmonise efforts towards the standardization of at-sea monitoring programs in the SWIO with the objective of achieving consistency in the identified key areas of importance, in a quick and efficient manner.

1Comoros, France (Reunion Island), Madagascar, Mauritius and Seychelles.

2Such initiatives are sponsored by research institutes, fishing fleets, regional projects, Regional Inter-governmental Organisations (RFO) and Regional Fisheries Management Organisations (RFMO).

Session 7. Briefing and debriefing observers

Leader: Jennifer Ferdinand and Jennifer Mondragon

The process of briefing and debriefing observers is at the intersection of data collectors and data users. Trainers and briefers prepare observers for the challenge they face at sea; program staff support observers while they are in the field; and debriefers conduct data quality control measures and ensure that the best available science and compliance information is available to support sustainable fisheries. Training, briefing, and debriefing staff are often the touchstones for observers -- they are the mentors, the evaluators, and a safe, understanding ear. The interaction between observers and briefing/debriefing staff is vital and yet the time we have to spend with each observer is often incredibly short. This session focused on methods for ensuring that we make the best use of the few days, hours, and minutes that staff have to interact with observers. The session included presentations from observer programs in Canada, Ireland, New Zealand, and the West Coast and Alaska of the United States.

Oral Presentations - Extended Abstracts

Briefing and Debriefing in British Columbia

Ian Hamilton

Archipelago Marine Research, Canada

Archipelago has a relatively long history of providing at-sea monitors to commercial fisheries. Today, over 90% of our sea days are on a 100% monitored groundfish trawl fishery which provides high demands for flexibility and mobility within the program. In addition to challenges that have existed in the program since its inception, such as the diversity of species, vessels and methods of estimation, new technologies have added requirements for training, briefing and debriefing.

Training diverse staff for electronic data capture methods, hardware, software, operating systems, security and device policy requires new perspectives and considerations. Depending on age and background, staff can have very different baselines of understanding of digital devices and processes.

Briefings can be delivered in a way that suits these varied baselines for either the observer or briefer. We have designed a simple deployment app with an intuitive card-based user interface that allows us to match observers to vessels, and automatically generate and distribute detailed briefings to the observer’s field tablet. If desired, the briefing can be sent from the app to email or remote printer to suit the requirements of the observer or briefer. Additional briefing materials can be distributed via a remote drive app that provides an internal and secure two-way conduit for information. Similarly, after a trip an observer can utilize mobile devices and apps to submit data, images and scans of paperwork.

At Archipelago we brief and debrief for every trip our observers go on. We utilize a tiered system to provide appropriate levels of information and feedback. Our “Level 1” briefing or debriefing can be generated automatically by the deployment app, and our data auditing procedures. They are provided to the observer and follow up can be initiated by either observer or operations staff. Our “Level 2” briefing or debriefing is designed to be a more in-depth one-on-one meeting with a trainer.

On top of the benefit of being extremely versatile to suit the training and learning requirements of individuals, our app ecosystem has also allowed us to be extremely mobile. Because they are accessible from a variety of devices, briefings and debriefings can be done remotely from almost anywhere, to almost anywhere, at any time, vastly reducing costs and manpower requirements. This also allows the trainer to travel directly to the deployment port to do an in-person “Level 2” briefing or debriefing in concert with live data auditing, without needing to coordinate the transport of PCs, original documents or samples.

Through the adoption of simple but powerful apps and technologies we have been able to brief and debrief observers at a level appropriate to the trip, with a method appropriate to the person. We do this for one hundred percent of trips while maintaining a lean operations staff and low cost.

Briefing and debriefing in New Zealand

Andrew France

Ministry for Primary Industries, New Zealand

The New Zealand Observer Programme delivers approximately 10,000 seadays a year (a seaday being a day an observer is on a vessel at sea).

Observers are placed on vessels undertaking one of the following fishing methods: bottom trawling, mid-water trawling, bottom longlining, surface longlining, purse seining and set netting. Vessel trip durations range from day trips, with no overnight periods, to trips of three months (or slightly more).

Observers are briefed before every trip and specific priorities and requirements for the trip are clearly explained. For the majority of trips, briefings are conducted face to face between the observer(s) and the briefing officer (shore staff member overseeing the trip). Occasionally the briefing occurs over a phone call. Printed trip specific briefing instructions are provided to the observer(s) for them to take with them on the trip and all aspects of the briefing instructions are discussed between the observer(s) and the briefing officer to ensure all instructions are clear and understood.

The vast majority of trips observers undertake are on vessels that have previously had observer coverage. The Trip Report from the most recent observer trip on the vessel is provided to the observer(s) for the trip being briefed for. Specific emphasis is given to two sections of the Trip Report: *Conditions On-Board* and *Observer Hand Over Information*. The *Conditions On-Board* section is where the observer briefly describes the functionality of the vessel facilities and whether observer's tasks were impacted due to the conditions. The *Observer Hand Over Information* contains information which may be helpful to oncoming observers. It is purely for the purpose of assisting fellow observers to be more comfortable on the vessel and to share information to make the job a little easier when on a new vessel.

When deployed on a trip, observers are instructed to contact the office once a week and to provide a weekly summary of the target species and areas fished, protected species captures and biological sampling undertaken. Observers are also instructed to contact the office as soon as possible if particular events occur. Observers are also encouraged to contact the office if they are unsure of any of the tasks they are required to undertake, or if they need advice.

It is a statutory requirement for observers to have access to the communications equipment of the vessel and to receive and transmit messages and communicate with the shore.

When deployed on larger vessels, the communication between the observer and the office is through the vessel's satellite email system. When observers are deployed on smaller vessels that don't have satellite email capability, and are operating in areas where there is no cellphone coverage, they are generally not at sea for more than three days at a time. There are, however, a couple of vessels that observers have been deployed on that didn't have a satellite email system that the observer could use, were outside of cellphone coverage range, and the voyages were for 10 days. This was unacceptable from both the observers' and the office's perspective.

To address the issue of observers not always being able to communicate with shore staff, the programme purchased some Garmin inReach devices. These devices provide independent two way communication between at sea observers and shore staff. The inReach device operates via the Iriduim Satellite Network independently of the vessel that the observer is deployed on. The devices allow two way text messaging, GPS tracking, and an emergency SOS functional which communicates directly with the International Emergency Rescue Coordination Center (IERCC). These devices further improve our health and safety management of at sea observers by allowing independent two way satellite communication 24 hours a day.

We are also investigating the options, costs and feasibility of implementing daily reporting via satellite from observers at sea. This has the potential to improve our efficiency by allowing reprioritisation of observer tasks while observers are still at sea. This will be particularly useful on the larger vessels which change target fishery mid-way through a trip, and the observer was not briefed for that fishery. It will also enable observers' biological sampling requirements to be increased mid-trip when less vessels with observers onboard operate in the fishery than was planned for. It will also allow for some errors to be identified while observers are still at sea, which will enable those errors to be rectified at source in near to real time.

At the end of every trip, observers attend a debriefing, which is perhaps the most important part of a trip from a shore staff perspective, and may be the only opportunity for shore staff to learn more about the trip than what is included or evident in the reports and forms that observers complete.

During debrief sessions, shore staff personnel ask questions about:

- Trip paperwork
- Sampling and data collection methodologies
- Reasons why it was not possible to collect the data required
- Conditions on board
- Anecdotal information contained in the paperwork
- Compliance issues
- General vessel attitude to the observer
- Any accidents/safety issues
- Any general problems/concerns

The observer collected biological and catch effort data is also reviewed and any errors are corrected. The observer's performance regarding various aspects of the trip are discussed face to face in this debrief forum. A more detailed, written Performance Assessment is completed following the debrief session and provided to the observer.

The Performance Assessment supports the following purposes:

1. Give feedback to observers on their performance in relation to trip requirements and the Ministry's Code of Conduct;
2. Gather more information and understanding from debriefs;
3. Emphasise trip outputs and key aspects of observer work;
4. Encourage consistency in grading observer work;
5. Provide a support document for Observer Services' performance relative to client requirements on a trip by trip basis.

The Performance Assessment is designed to give weighting to:

- Trip priorities;
- Trip outputs; and
- Where possible some individual tasks (relative to time and effort).

The Performance Assessment process encourages observers to engage and share more information, as it can have an impact on their pay. There are 11 pay rates applicable for observers. All new observers start on the lowest pay rate and over time can move to higher pay rates based on their performance assessments. A review for pay progression is undertaken after an observer has completed 120 seadays, and incorporates all performance assessments for the review period.

The Performance Assessment process also encourages de-briefers to ask more questions at debrief sessions and find out more information. Observers are the eyes and ears in the field and it is important that shore staff personnel gather as much information as possible from observers at a debrief session, which this process facilitates.

Cultivating Data Quality and Continuity in a Large Observer Program.

Melanie Rickett

NOAA Fisheries, USA

The North Pacific Observer Program (Observer Program) data are used by the Regional Office to monitor and manage approximately 600 quotas inseason, and the final data sets are used in a plethora of annual stock assessments. Consequently, these data must be of the highest quality both in-season and in the final post-season data compilation. To realize this high quality standard, the Observer Program trains/briefs and deploys approximately 470 observers annually in Alaskan waters. This extrapolates to approximately 800 debriefings completed per fiscal year.

The Observer Program fiscal year is measured from the first of October to the end of September. In fiscal year 2017 (FY17) the Observer program was made up of 30 staff members, of those 12 were core debriefing staff, who have the knowledge and ability to debrief. The main focus of the debriefing process is to ensure data quality and the continuity of data sets. In FY17, debriefing staff conducted 790 debriefings, which were comprised of 1,674 data sets. Of the debriefed data sets, approximately 40 were slated for major deletions, accounting for roughly two percent of all data collected in 2017 (figure 1).

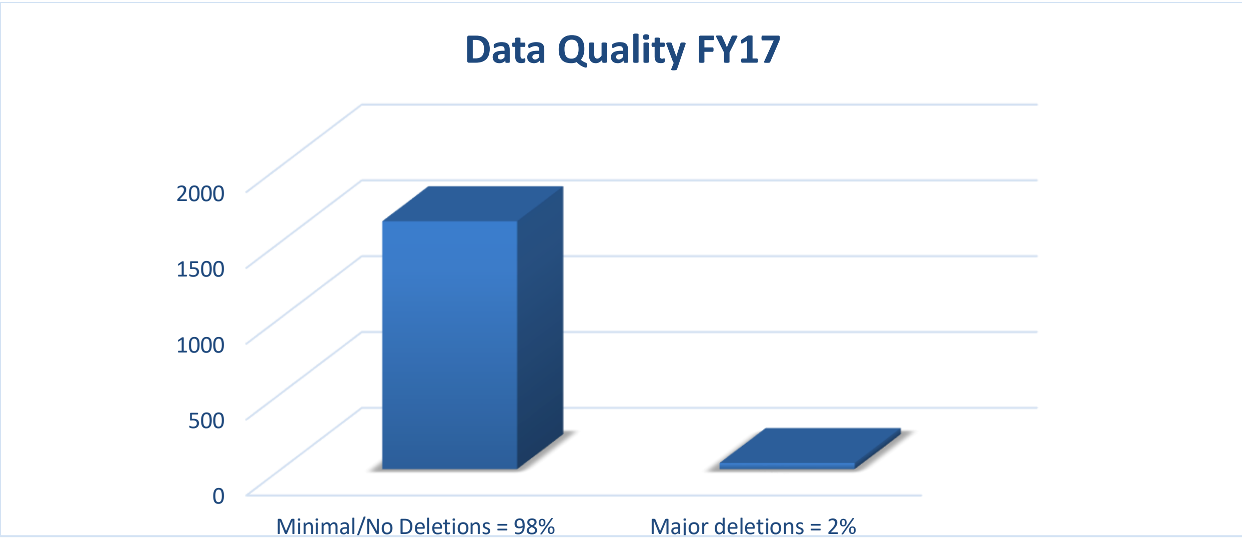

Figure 1: Total number of datasets debriefed is ~1674 and of those ~40 were found to have major deletions (~2 percent)

The Observer Program staff uses multiple tools throughout an observer's deployment and during the debriefing process to achieve its goal of quality data for inseason management. While all North Pacific Observer deployments start with a training or a refresher briefing, data quality review starts as early as the first day the observer steps foot on the vessel. In some cases, observer data can be debriefed while the observer is still deployed to the field. Regardless of whether the observer data are debriefed in or out of the field, the same control measures are taken. Although there are many control measures implemented by the Observer Program, there are two primary tools used by Observer Program staff to ensure these data meet the programs data quality standards. These two resources are the Data Quality Control Managers, and a Debriefing Continuity Guide that help ensure that all data are processed, edited, and evaluated using consistent documented protocols. The Observer Program has two Data Quality Control Managers. The first manager holds a position in the IT group reviewing inseason data that is submitted electronically by both the observer and industry. The second manager works closely with the debriefing staff and observers reviewing raw data and sampling methodology both during inseason and during the final debriefing process. Both of these Data Quality Control Managers work with the Regional Office and industry to relay any data issues or pending data deletions. The second resource for data quality is the Debriefing Continuity Guide is a series of files that are maintained/reviewed/revised quarterly as debriefing protocols and polices change. These files contain not only final debriefing guidelines, but also inseason advising and mid-cruise debriefing materials.

In-season advisors start the debriefing process by reviewing observer sampling and data collection methods within the first week of an observer’s deployment and continue throughout as methods may change. The inseason advisor is imperative to helping our program maintain the best quality data throughout an observer's deployment. Each vessel that is required one hundred percent or greater observer coverage is assigned an inseason advisor. This advisor has detailed knowledge covering preferred sampling methods, and is aware of unique sampling challenges that take into account any known mechanical biases on the specific fishing vessels. As outlined in the Debriefing Continuity Guide, the in season advisor is required to review the sampling methodology within in the first few days of observer sampling. Additionally, the advisor responds to any sampling or data questions throughout the observer’s deployment on that vessel, reviews all data at minimum once a week, and transmits via the at sea communication application (ATLAS) data/error reports for observers for review. Any data and sampling issues detected or reviewed with the observer are documented by inseason staff in an Observer Logistic System database. These logistic notes aid the final debriefer in evaluating and reviewing the complete dataset at the end of the observer’s deployment.

Another major element to an observer deployment that helps prevent mass data loss is the mid-cruise debriefing. The Observer Program requires that all first and second time observers complete a mid-cruise debriefing early in their deployment. A mid-cruise may be assigned at the time of the previous debriefing to observers who have struggled with basic program protocols and sampling methodology. These mid-cruise debriefings are most often a face to face interview between the observer and one of our field or debriefing staff. In this interview, sampling methods are reviewed in great detail, along with the review of the raw data collection. Error scripts created by program IT staff are used to review data more efficiently. In FY 2017, the Observer Program conducted one-hundred and eighty eight mid-cruise debriefings, representing 24% of the deployed observers (figure 2).

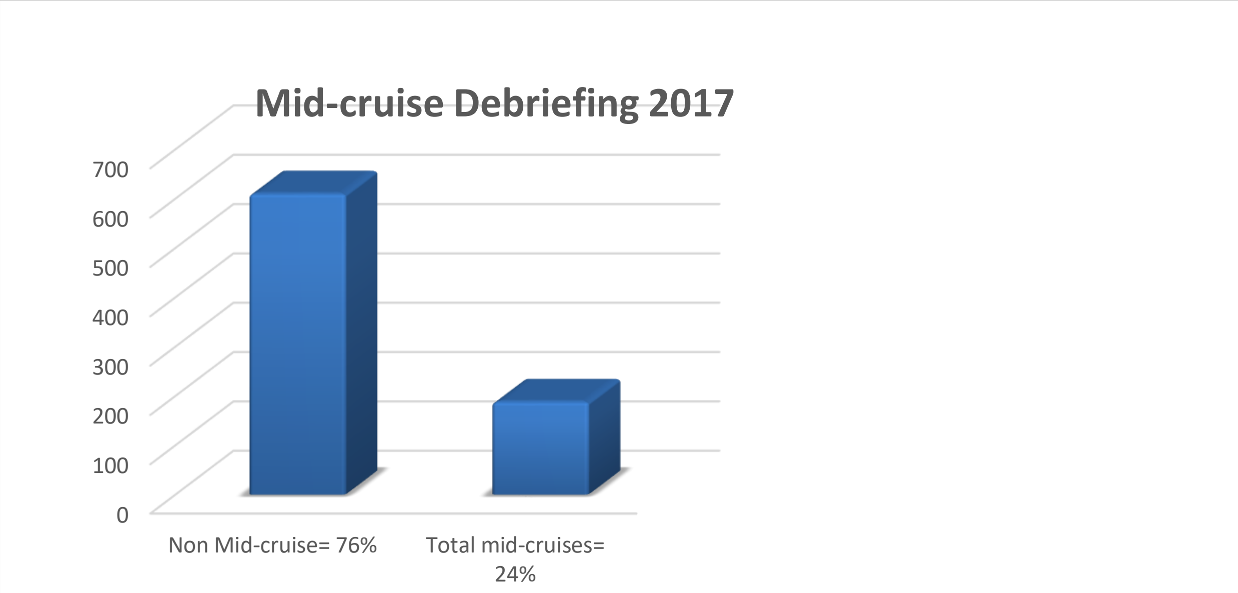

Figure 2: Total number of observers debriefed was 790, and of these 188 completed a mid-cruise debriefing (~24 percent).

The final stages of the debriefing process occurs when the observer leaves the field and returns to one of the main debriefing offices. During the final debriefing, all observers conduct another face to face interview with a debriefing staff member. The observer will complete a vessel/plant survey for each assignment which covers sampling methodology, data collection/documentation, safety and compliance issues, and other miscellaneous issues that arose throughout the deployment. This survey is subsequently used by the debriefer as a point of reference to conduct the interview. In addition to the survey, debriefing staff review all logistics notes that were documented throughout the observer's deployment. These notes help the debriefer identify when sampling methods were changed, why it was changed, and how it may have affected the data. Since deletions do not occur in the field, logistic notes are also used to identify any data deletions that may have been detected by the inseason advisor or by the Data Quality control managers. Throughout an observer's deployment, the sampling methods are reviewed multiple times. This repetition may be time consuming, but it is imperative in detecting fine details or bias that may affect the quality of the data collected. After the interview, the debriefer and observer work together to make any data edits. During the data editing process the debriefer ensures that all data entered into the electronic database matches the raw data documentation, and that any biased data are removed from the database. These data edits may be as simple as data transcription/keypunching issues, or as serious as mass deletions. In the case that data are found to not meet the programmatic standards by the debriefing staff, they are removed from the database. These cases are addressed with the Data Quality Control Manager and relayed to the Regional Office prior to removal of data from the database.

Once the final data edits are made, the debriefer will give the observer a final score along with a verbal and written evaluation. Each vessel is scored with a pass or fail scoring system. A score of one indicates that the data collected and observer sampling methods met the programs expectations, while a score of zero denotes that the program's expectations were not met. The evaluation consists of a training requirement for the next deployment, a mid-cruise requirement when necessary, and an overview of the overall observer performance and data collected. This evaluation gives observers a clear understanding of what was done correctly, and what needs to be improved upon in future deployments in order to continue collecting the highest quality data possible. The scores and evaluations are kept in a database and can be reviewed for trends, and repetitive data collection or sampling mistakes in future debriefings.

The relationship between the Observer Program and Regional Office helps to ensure relevant data is maintained for both in-season management and stock assessments. Additionally continuity among debriefing and training operations enables the program to manage a massive number of data sets for quality inseason quota management ultimately preserving our living marine resources and sustainable Alaskan fisheries. Data quality is the priority, and this quantity is the byproduct of a transparent and solid training/briefing/debriefing process.

Debriefing the Paperless Observer

Jason Eibner

NOAA/ Northwest Fisheries Science Center, West Coast Groundfish Observer Program

In January 2018 the Northwest Fisheries Science Center's (NWFSC) West Coast Groundfish Observer Program (WCGOP) began deploying a newly developed paperless data collection system with observers working in west coast trawl fisheries. The Observer Program Technology Enhanced Collection System (OPTECS) facilitates not only observer data collection, but the data review/ quality assurance process as well. This presentation briefly covers the current WCGOP paper-based data review process, details OPTECS features, and then describes the paperless data review process, noting the intended benefits that will enhance and simplify review.

The WCGOP program covers a large geographic area, the entire U.S. West Coast from Canada to Mexico. Paper data is generated at sea by observers in each port group along the coast. Once complete, the forms are shipped to the nearest office (6 locales) to be reviewed by a staff debriefer. Data forms with errors are shipped back and forth between an observer and debriefer to be edited as necessary before being finalized and ultimately shipped to a warehouse for archiving. The WCGOP data review process involves examination of all raw data, verification of calculations, checks for anomalies, and a comparison of data forms to database entry to catch any transcription errors made during manual data entry into the database. Trip review time is based on a host of variables such as trip size (1-20+ hauls), observer and data quality, the number of errors, and catch diversity. Data review can take from 5 minutes, to a few hours, to a day or more, with the most time consuming and tedious aspects of the process being calculation verification and comparison of data forms to the database entry.

The OPTECS system is comprised of a rugged tablet, Marel scale, a stand to hold the tablet, and a user interface application that facilitates data documentation. It was designed to follow the events on deck and guides the user as catch is sorted, sampled, and stowed. Error checks warn the observer of issues at the point of entry and trip checks can be run at any time to list all present errors. OPTECS data fields are functional and the application completes all calculations for the user.

Observers enter data directly into the tablets via the application and these entries are the raw data. The error checks help ensure all required information is documented prior to disembarking the vessel, and reminds the user when biological samples are to be collected before they are accidentally tossed overboard. Tablet data is synced with the WCGOP database upon establishing an internet connection when the observer returns to port. Additionally, the data is backed up to a thumb drive on a regular basis and the backup file is also synced to the database allowing debriefers access to the tablet entries which facilitates data review. Syncing raw data to the database, rather than manually entering it, eliminates the inherent transcription errors as well as the need for comparison of the raw data to the database. Moreover, since there are no longer calculations to be checked, OPTECS has successfully removed two of the most time consuming and error prone aspects of data review. Essentially debriefers review a trip for species and weight anomalies rather than math or transcription errors. The application displays species' average weights to provide a size reference that allows debriefers to assess if weights are within an appropriate range.

- The benefits gained in the OPTECS data review process include:
- No calculations to check and no data entry comparison to make
- Elimination of transcribed data
- Observer data legibility is no longer an issue
- Elimination of plastic "paper" forms and associated costs
- No shipping delay to get data, sync is immediate.
- Elimination of shipping costs
- No physical warehouse needed for archiving
- Error checks catch issues at point of data entry before sample is tossed
- 1/3 – 1/2 total review time saved per trip
- Enhanced observer performance as the application guides the user through sampling protocols. (Particularly useful for new observers during their first few trips when errors are more likely)

Since January of 2018 the WCGOP has deployed 10 OPTECS tablets with observers in the field, and the intent is to increase that number through 2018 to reach full operationalization across the program. Future plans for system improvement include:

- Additional point of entry warnings such as the use of species weight and habitat ranges to ensure data fit within expected ranges, and a prompt when completion of a species id form is required.
- Automation of random sample selection to facilitate adherence to sampling protocols
- Digitize and integrate supplemental data forms

- Bluetooth connect tablet to Marel scale
- Integrate barcode reader for scanning in specimens
- Enable tablet GPS to document location information
- Continue to develop and test the fixed gear application with potential for full deployment in 2019

Effective Communication with Observers

Sara-Jane Moore

Marine Institute, Rinville, Oranmore, Co. Galway, Ireland

Fisheries observers not only collect data but also are a critical communication link between scientific organisations and the fishing industry. Successful catch sampling programmes depend on strategic and effective communications. Issues need to be addressed immediately and professionally before they spiral out of control or worse are forgotten about. Using a few different approaches, communication protocols with observers working in the Irish catch sampling program have improved in recent years. This talk highlights various innovations and plans for continued improvement.

The Marine Institute catch sampling programme has been in operation since 1995 carrying out approximately 80 trips a year. Recently, there has been a change in model from one based on full time Marine Institute staff to one based contracting of external observers.

Observers are trained initially on shore through a series of detailed presentations and completion of a "workbook story" of a real catch sampling trip. This method gives a clear understanding of how to carry out a trip, engages the observer, promotes discussion and is very effective in giving a complete understanding of the data that needs to be recorded.

To organise trips, the Marine Institute uses "Teamup", a shared calendar app for groups that allows observers to state their availability and their preferences for type of catch sampling trip. "Teamup" can be accessed online and is available as an app on both android and IOS platforms. This streamlined type of communication has been proven to be easy to use and cuts down on continuous phone calls to observers to check for availability.

Another innovation is the "Who's at Sea" app developed by the Marine Institute. This is an SMS based system linked to a Marine Institute application. An online version is also available. Important trip metadata e.g. departure port, time, vessel details, expected return date etc. are logged by the observer via text message. This system has huge safety implications as at any one time a full list of observes at sea can be accessed by phone or online. Furthermore, it is used to check what ICES areas observers are in so that ancillary sampling request can be made. Communication at sea is often dependent on the vessels communication infrastructure. In recent year's satellite, internet or email facilities at sea have become more common and are used to answer queries pertaining to catch sampling *in situ*.

A key aspect of any scientific sampling programme is ensuring the quality of the data collected. Following disembarkation, data or other queries from the observer or industry are communicated either by email or mobile (verbal or text). These are systematically addressed. Completed data sheets are evaluated via a “Feedback form” which outlines any quality issues, e.g. missing data or fields, with the observer’s data. General comments and a quality scoring are relayed to the observers. The intention being to prevent repeated mistakes and improve quality control (Figure 1). Further quality reports are produced that look at data anomalies, raising factors, tow and length data. Any inconsistencies or issues that arise then are relayed to the observer for further clarification. This is usually the last stage of trip based briefing/debriefing that occurs.

It is important that the Marine Institute integrate lessons learned by adapting the catch sampling programme to improve communication with observers. One technique adopted is that after training is given it is valuated by the observers to measure its effectiveness and gather feedback to improve future training sessions.

The Marine Institute recently hosted a mini seminar with both experienced and inexperienced observers to share their tips on data collection, challenges faced and solutions found. It served as a refresher for protocols and data quality issues. Furthermore, it provided an opportunity for observers to exchange views and suggest ideas for practical improvements in protocols currently used. The plan is to make this a biannual event.

Trip	FAT/CTB/17/7
Sampler	XXX
Boat Name	XXX
Depart Date	11-09-2017
Return Date	18-09-2017

Data Inputted By	XXX
Date of Comments	12-12-2017

Followed up By:	XXX
Date of Follow Up	14-12-2017
Sampler Comments	

Please use the following Quality Ratings
(1= Poor, 2= Fair, 3= Good, 4= Excellent)

CRUISE SHEET	**Quality Rating =4**

HAUL SHEET	**Quality Rating =4**

- Not entering discard samples and landing samples (units) on haul sheet

MEASURED ONLY SHEET	**Quality Rating =2**

- On the discards sheet, confusing when entering the data as species sex are all added together. Eg: Lesser spotted dogfish, M/F tally together
- Quantity not written in for landings

RETAINED CATCH TALLY SHEET	**Quality Rating =4**

- No “female whole” dropdown or large/small tails to choose from – had to add the quantity together

Figure 1. Example of Feedback form to Observers on quality of data sheets.

Open Discussion Session

Q: The presentation about the paperless data entry method being used on the West Coast of the US talked about the cost and the time savings to the debriefing staff. Has there also been a benefit for the observers? And if so, do you have data-users that are asking for additional data that could be now collected due to time savings?
A: (US – West Coast) Yes, there are many benefits for observers that come from not having to do manual data entry and complete manual calculations. Previously, they collected the data on the back deck and then had to spend considerable time processing their data. That step is pretty much eliminated and so they have a lot more free time. Our intent is to take advantage of this extra time to collect more biological samples and environmental data.

Q: A couple of the speakers indicated that they use the debriefing process to evaluate the observers. Do you also have a process to evaluate the debriefers? In the Western Central Pacific fisheries, we have around 1,600 observers and many debriefers. In this very large scale program and we need to develop an effective method to evaluate our debriefers but we don't yet have a good system.
A: (New Zealand) Yes, we have a number of debriefers and any one of them can debrief a particular observer, over time. The observers give us feedback on how well the debriefing sessions are going. The information provided by debriefers is incorporated into the observers' performance assessments, which can impact on their pay, so observers are keen to provide feedback about the debriefing process. If we get inconsistent messages between debriefers about an observer, the observer will not happy about it and they are able to elevate that to the program managers.
A: (US - Alaska) In the Alaska observer program there are several methods that our observers can use to evaluate the debriefers. The first is the Post Debriefing Survey, which is completely anonymous. Observers can specify the debriefer by name and put in comments to specifically say "I had an issue with this debriefer" or "this debriefer was great." I think that the anonymity of the post debriefing survey is critical. The supervisors of debriefers also have an open-door policy. So observers can go directly to a debriefer's supervisor and inform them of any issues. We also have an "Observer Liaison" among the observer program staff and observers can go to directly to her in her private office or contact her via email or phone. She plays a vital communication role between the observers and any of our staff and they do utilize her. Information from any of these sources and suggestions for improvement is conveyed to debriefers in the feedback they receive during a mid-term and final performance reviews each year.

Q: In the Alaska Observer Program, can you tell us a bit more about how you evaluate the species identification of fish that observers report? Do you use pictures, an app, or live fish? Also, can you give us more information about the fish test?
A: (US - Alaska) We have multiple tools to evaluate species identification. All of our observers are deployed with a species identification key that they use to complete species identification forms. These are standardized forms that have developed for different groups of species: Rockfish, Flatfish, Skates, Sculpins, Salmon and miscellaneous species. Observers are expected to fill out the forms while they are looking at the fish in the field. We also ask them for a verbal description at the time of debriefing. This is from memory and we want

them to recall what they saw. We listen for specific things. For example, are they identifying the difference between two fish and are they telling me "my fish had this characteristic, but I know it is not that fish because it didn't have this." In addition, we do deploy observers with cameras, which are very helpful if the observers have the chance to take photos. Finally, we sometimes ask observers to collect fish. For example, if we have an observer that has had significant issues with species identification, we may require that they bring back a specimen for every fish they see. The specimens are then reviewed by a taxonomist.
The "fish identification test" is a test that all observers are required to pass during training. We train them on all of the species that they could see in the field. At the end of their training they take a test on 15 fish and 6 crab species. They must identify all of those and pass with 80% or higher. In addition to passing the test during their first training, they also take the test again every year.

Q: Could you tell us a little more about the observer performance assessments used in New Zealand?
A: (New Zealand) The performance assessment occurs during debriefing when there is the opportunity to look at data and also to talk to observers. The assessment starts during briefing and lists all the primary aspects and sampling priorities that all observers have to do, and then it is tailored for trip specific requirements. The goal is to clearly list out the sampling priorities and then assess against those to ensure high-quality data. Observers know ahead of time that they will getting marked against those priorities, which makes a fair process.
As an example: A single observer on a deep-sea trawler is deployed for 5 weeks and in a particular fishery. Their requirement might be to observe the hauling of the net at least 66% of the time. The performance assessment during debriefing would evaluate whether that standard achieved (Yes or No)? If it was not achieved, but there was a valid reason (such as an observer who was sick) then that is taken into consideration. Did they measure enough fish? They are required to sample the target species once a day and measure 120 fish and sex them all and weigh them. Did they do that (Yes or No)? There is also an overarching a code of conduct. So if they have done something really bad then they are not going to get a good performance assessment, regardless of how the rest of trip goes.
We are also able to modify the assessment process depending on what the vessel ended up actually doing. We brief observers for what we hope the vessel is going to do, or said they were going to do, and where they meant to go. But sometimes they end up fishing for something completely different. For this reason, communication during the trip is really important and sometimes we change sampling priorities mid-trip.

Q: With the development of electronic data entry software and debriefing applications for observers, there is a shift away from manual checking to an automated quality-control checking of data. Is there still potential value to having observers conduct manual data checks? They used to do things like tallies or totals of lengths for all the fish and these checks ensured that observers went back and reviewed and checked their data. As we move to digital, we obviously want to automate data checking, but is there also value in having observers and the debriefers looking at the numbers?
A: (US – West Coast) It is interesting not having to complete all those manual checks – we can now look quickly at a trip and see that it is mostly error free. However, it is also very valuable to be able to go back and look at tablet data, which is what basically the raw data and provides a little finer resolution. I look at that and compare it to the database to ensure

that we getting the the same thing. So I do agree there is value in looking at raw data, but the benefits we have gained from not having to review calculations and not dealing with transcription errors is a huge improvement.
A: (Canada) For the last 4 years have been using electronic data capture as our primary method to capture information at sea. However, we still maintain a notebook. Three years ago we had an observer drop her gear bag into the ocean when she was disembarking the boat. Even though she had back up of her data on a thumb drive, the electronic copies were destroyed. So there is huge value in having a physical back up. Also, anecdotally, we have been finding with our electronic data capture that the user interface and the options and tools that are available can really affect data bias. For example, if you have a drop-down list of species to select from, it might be easier to jump to a conclusion, "oh yeah, it was that rockfish species." Whereas when you are writing information down on a piece of paper, on your own, you are really forced to identify things individually. If you are maybe slightly uncertain about your identification, the process of writing it down forces you to get the species identification and description from your mind, instead of just picking from a species code on a drop-down list. This has the potential to reduce the data quality of the species identification. So in designing data entry applications, we need to be really careful that the user interface isn't actually influencing how observers enter specific data.
A: (US – West Coast) It is also important to provide observers with an avenue to enter comments into the application. That way if they are uncertain they can add notes and comments. These comments are reviewed and question can be raised during debriefing to tease out any uncertainty.

Q: I am impressed with the high caliber of each of the observer programs the panel has described and I am curious how each of the programs is funded? Is it money from government taxing on the fishing industry? I want to be able to understand how to institute these types of briefing and debriefing protocols in developing countries, more specifically in East Africa and the Indian Ocean. In the Seychelles, for example, the money comes from government to run the observer program and the industry is being taxed. And a second question, do any of your programs place observers into very small-scale and artisanal fisheries?
A: (US – West Coast) Our electronic reporting software development has been funded through the federal government, specifically the National Marine Fisheries Service's Fisheries Information System and National Observer Programs.
A: (Canada) In Canada the observer program used to be federally subsidized but that shifted about 5 years ago and it is funded by industry now. The fishermen have to pay for observers to be on board. The observer program is still overseen and audited and certified by a government agency, but the industry contracts directly with the observer provider companies. And the observer providers have to keep costs at a level that allow them to maintain those business relationships. In regards to artisanal fisheries, I don't think with our funding structure that it would be feasible to put observers on board very small vessels. I think it would have to be an electronic monitoring solution.
A: (New Zealand) In New Zealand, it is primarily a government run observer program and the industry pays for the majority of the operation aspects of our program. Industries either pay through annual levies on the quota owners or for trips where vessels are undertaking specific activities that require they have an observer, they get directly charged for that activity.
A: (Ireland) Our program is funded by the European Union through the European Maritime and Fisheries Fund. As part of our funding, we send out a program annually to tell the EU

what sampling frames we are going to do every year and that does include some inshore, artisanal fisheries.
A: (US - Alaska) In Alaska, federal funds support the government staff that conduct observer program training, briefing, and debriefing. The observers work for observer provider companies and those are funded through two different mechanisms. In the full coverage sector, the fishing industry pays an observer provider directly to obtain their required coverage. In the partial coverage sector, there is a government contract for an observer provider company and that is funded through landing taxes on the commercial fishing industry. There are some small boats, 40 feet in length, in the partial coverage fleet and in those situations, it is usually just the observer and 2 crew on a small boat.

Q: Several of you mention that most of your debriefings are in-person. This is very different than in the North East of the US where we primarily do debriefings over the phone and very rarely bring someone in-house. Are you doing in-person debriefings every trip, even for day-trips? Or is this on a regular schedule, like every so many months? Also, do you find that bringing the observers in-house causes any disruption to them? For example, would they rather stay in the field and continue to get trips? Or do you find that the benefit of bringing them in-house outweighs any disruption?
A: (New Zealand) We do face-to-face debriefings. However, we don't usually send an observer to do a single day trip and then debrief them. Instead, an observer can be in the field for maybe 3 to 4 weeks doing a series of trips on smaller boats before they are debriefed in-person. We call this deployment a "trip" even though it really consists of many short trips out to sea on many different vessels. On the bigger boats, we deploy them a boat and when they come back to port 3 or 4 weeks later, we fly them back and debrief them in-person. An important consideration for us if observers are constantly out in the field and you only have a phone call with them, is that it is really easy for people to lose heart or not feel that they are valued. It is harder to build up that personal relationship and you are not actually sure if they are taking care of their wellness. It is helpful to see an observer face-to-face because some of them will say they are ready for another trip but you can see that they have done a few in a row and need some time out. You just can't get that over a phone. We think it is really important and although it costs us more, it is worth it.
A: (Canada) In Canada we have a small number of operational staff, so we need to run a hybrid model and do both – debriefing over the phone and in-person. We debrief after every trip, even if it is only a day long, but that is normally just a quick phone call and/or email. We have protocols that would initiate a longer debrief, which we try to always do in-person. We do an extended, in-person debrief if it is the first trip or two for an observer, or if they are going into a new fishery or on a new vessel type, or if they are on an extended or long trip (for example, if they are at sea for a month). There other things that can also trigger an extended in-person debrief, for example a year-end review, or if there is some sort of data performance issue, or if we get an indication from their voice over the phone that we need have a conversation.

Q: In South Africa, we use a system similar to the paperless observer system presented from the US West Coast where observers capture data electronically while at sea. But our challenge is that we have not been able to totally get rid of paper yet. Observer trips are 30-60 days and we don't have direct link to the database and therefore we are worried about losing the data, for example if the computer on the boat were to crash. Observers write down their data on paper and every day we do have a manual check of data before we enter

it into the master database. Sometimes when we debrief the observer we find that the data on the paper forms are not the same what we have in the database. So we are still not totally paperless. How do you deal with this situation? Does the data get transmitted from the vessel and backed-up on the server? Or does the observer bring it back on a tablet or USB drive? And if so, how frequently are they backing up the data on the thumb drives? I am looking for ideas to get rid of the paper, but our laptops sometimes have problems at-sea.
Also, as a comment, we have moved towards the system of observers entering data at-sea because we had challenges when we had with observer writing data down on paper and having a different set of people dedicated to keying in these data. We found that having people who have never been at sea trying to enter data did not work well. These people might be very good at entering data and typing but we encountered a lot of errors because they were just entering the data as is. An observer, however, will immediately see if something is wrong. For example, if a fish it is 10 cm and weight 100 tons, the observer will be more likely see these problems.
A: (US - West Coast) We will probably always still require observers to take paper along just for the type of situation you describe where a computer failure occurs. But the paper is not used unless tablet failure happens. The observers back up their data onto a USB drive while they are at sea and they do that after every haul. When they get back to land and have an internet connection they sync their tablet data to the database. Then we can view the exact keystrokes they made in the tablet. They also synch their USB drive to the database and transfer those files to our database.

Q: In the New Zealand program you talked a little about your compliance data and the fact that you have a code of conduct for observers. Can you talk a little more about how your staff use those data and, ultimately, do the observers get feedback on those reports?
A: (New Zealand) Yes, our observers have a compliance monitoring role in addition to other data collection. We give them a separate notebook that we call a diary, and they make notes on conversations and activities they see. We operate a 'Voluntary, Assisted, Directed, and Enforced' (VADE) compliance operating model, which provides a stepped sequence of actions to ensure compliance. Under 'Voluntary' compliance, fishermen are informed about expectations and obligations and they comply voluntarily. With 'Assisted' compliance, fishermen are informed about how to comply in a particular situation. Then it steps up to 'Directed' and 'Enforced' compliance, when non-compliant behavior is detected and more directly enforced. The observers fit into the voluntary and the assisted part of this model. So if we see a vessel operating illegally, we will assist them to improve their performance. For example, if they are not allowed to discard a quota species but someone in the factory discards a quota species, it might be due to a genuine error. The observer would assist them in improving their compliant behavior by ensuring they understand that this is a quota species, showing them a picture, and explaining the rules. If the observer sees the problem again, they may talk to the factory manager about it and they would elevate it to the skipper. Eventually if the behavior continued, the observer would start taking contemporary notes or video footage and during debriefing a compliance officer would come and talk to them about those issues. On rare occasions an observer could even end up in court giving evidence.

Q: At the International Pacific Halibut Commission (IPHC) we have a program that we have initiated for staff on our survey vessels that is similar to US West Coast paperless observer

system. We do not use paper and instead the data is entered electronically. We also have a similar system that we use for our dockside port samplers to electronically collect data from fishermen's logbooks. In that system, we are actually looking at checking the accuracy of the individual samplers and how well they are able to input the data. Historically, we have collected data on paper and then we have done double entry in the office. So we are attempting to mimic this by conducting accuracy assessments of each observer or each port sampler to determine whether we have high quality data and therefore they are cleared to go paperless. Did you do any similar between-user testing?
*A: (US – West Coast)**.** Part of our challenge was trying to figure out how to transition into the paperless data collection method and so we started off giving it only to the most experienced observers. We started with maybe 10 or 12 of our most experienced people and we had them to collect paper data and also use a tablet for their database entry. So we still had paper data as the backup. Initially we had them do that for 3 trips – using both paper and the tablet – and this allowed them to become familiar with the tablet. So we did an assessment to see how it went before the observers were allowed to go paperless. This enable us to do a gradual incorporation of electronic data capture.*

Q: At the IPHC, as we moved to entering all of our field data into a tablet, particularly during our fishery independent stock survey, we have modified the quality control process. Previously we would go back through the data at the end of the season and try to understand some of the errors that are showing up. The tablet has allowed us to troubleshoot some of those issues right away. For example, we have error checks that pop up messages such as, "are you sure that this is an animal of this size or this sex?" We also built some forensic aspects into our system. If a user realizes they have made a mistake, they can go back and correct it. Are you using any forensic steps to evaluate frequent errors that are being corrected? Or evaluating choke points in your data entry system that allow you to look at quality control?
A: (US – West Coast) No, not at the moment. But we are recording all keystrokes, so that would enable us to go back and see how the data entry and where data corrections occurred.
A: (Canada) We don't record keystrokes but we have a data entry and submission process. Once an observer has entered their data into the tablet and submitted it, it is audited and edited by a data technician in the office. Once it has been submitted, it is locked and can't be changed or adjusted. So we always have the data as it was entered initially, and then we have the data corrections that are made by the data technicians so that we can go back through and see all the changes that have been made.

Poster Presentations – Extended Abstracts

Comparison of In-Person versus Remote Debriefing, USA NMFS Northwest and NMFS Southeast Regions.

Patrick Carroll

NMFS SE Fisheries Observer

As a longtime observer I have had the opportunity to spend significant amounts of time in both the Alaskan and Southeastern observer programs, both under the National Marine Fisheries Service {NMFS}. With 5 years and around 750 sea days in the former and more than 1300 sea days and 13 years of experience in the latter . I have had much experience with both in-person and remote debriefings

In the NMFS Northwest observer program debriefings are done in-person, after the data has been initially handed over and entered in to a data base. Prior to debriefing the data is analyzed, and probable errors are flagged with percentages of a likely error. These flags are reviewed in-person with the observer, and corrected. Debriefings sometimes could take 2 days, but were usually finished in In one day. Scheduling and availability sometimes meant that the observer could wait up to 10 days to debrief, days for which they were not typically paid after a long deployment.

In the Southeast observers mail the data to their office, where it is checked line by line by office personnel, typically coordinators. After it has been checked the observer is sent an email, listing any problems or question about the collected data, and given a trip score based on both the quality of the data, as well as numbers of errors and typos in the data set. These are discussed over the phone, and recommendations made be made. Typically the debrief process takes about a week , with the observer's actual contact time with the debriefer being the length of a phone call, typically 20 to 40 minutes, though the debriefer may spend 3 to 10 hours on checking the data set.

In-person debriefing could be possibly improved by the employment of teleconferencing programs, which would allow the observer to travel home after a long contract. This would be particularly useful if there was a long delay in debriefing. Observers could initially visit to the office to return gear and process samples, and be questioned about any immediate needs or concerns, such as health or contractor problems. After this process the observer would be free to return home, hopefully in accord with return airline tickets, or employer paid airfare. This would save the observer a significant amount of money, in necessities and airfare scheduling changes. A final debriefing could be done over Skype or a similar program, at the convenience of the debriefer.

Remote debriefing could also be improved by the use of video conferencing in a the following ways. The first would be to create a better sense of empathy between the debriefer and the observer. The second would be to facilitate more involvement in the debriefing process by the observer. Face to face communication, either in person or through video conferencing is much more effective in transmitting information than over the telephone. Remote debriefing could also be much improved by utilizing data entry programs that would prescan the data set prior to debriefing. This might help resolve the frustrations of dealing with data sets on paper., and reduce the time, effort and expense of making corrections and changes to them. Simple spread sheets could also much improve and expedite data reflecting time of fishing activities in the formats requested by the programs, as well as ensuring the accuracy of simple repetitive calculations.

There are a number of good practices particular to each debriefing process, some more obviously inherent than others. Some of these practices have good consequences that could be reproduced in the other through the use of technology, such as video conferencing and pre digitation of data prior to editing. Also, use of such technology could promote both better retention of observers and communication and connection between observers and coordinators

I would like to thank the Atlantic States Marine Fisheries Commission for funding my attendance at this conference. I would also like to thank all the great people I have met over the years in the National Marine Fisheries Service Northwest and Southeast regions. Finally, I would like to thank all the fisher folk who have had me on their vessels over the years as an observer.

Abstracts of presentations that did not provide Extended Abstracts

Observadores pesqueros en la pesquería de vieira patagónica (Zygochlamys patagonica) en el Mar Argentino. Evaluación de desempeño.Aportes al conocimiento

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Instituto Nacional de Investigación y Desarrollo Pesquero

En 1996, y a partir de alentadores resultados biológico-pesqueros logrados mediante un poco frecuente y exitoso programa cooperativo de investigación Estado-Empresa, se inició formalmente la pesquería nacional de vieira patagónica (Zygochlamys patagonica) en el Mar Argentino. En ese entonces, la presencia de Observadores del INIDEP en viajes de pesca experimental fue fundamental para el conocimiento de la distribución espacial y distintos aspectos biológicos de la especie, así como también la metodología de captura y procesamiento de ejemplares a bordo hasta el producto final o callo.

La pesquería de Vieira patagónica cuenta con el mayor porcentaje de cobertura con Observadores a bordo de la Argentina (históricamente cercano al 100% anual), con información en forma interrumpida desde el inicio de las actividades.

Al llegar a tierra, los archivos de cada marea son controlados por personal Científico Técnico del Programa Pesquerías de Moluscos Bentónicos con buenos resultados a partir de la incorporación del Observador en la corrección de sus errores. La evaluación técnica del trabajo incluye rutinas de control para la detección de errores o inconsistencias, las que se completan con la descripción por parte del Observador de las tareas realizadas y las características de la marea. A partir de la información aportada por Observadores que demostraron gran interés por el trabajo, se realizaron modificaciones en el protocolo de tareas que llevaron a optimizar la obtención de datos, colaborando con la interpretación del resultado final.

A lo largo de la historia de la pesquería, las empresas se han esforzado en pescar y procesar de forma más eficiente, introduciendo cambios en los buques (equipamiento de puente, modificaciones en las plantas procesadoras o en el arte de pesca, etc.) que solo pueden ser identificados por estos Observadores calificados. El testimonio de algunos de ellos, incluso es relevante para algunos Capitanes que han aprendido a capitalizar su experiencia. De los buenos y malos resultados obtenidos durante algo más de 20 años, se puede concluir que la entrevista personal, resulta un recurso invalorable donde cada Observador aporta distintos enfoques a un mismo tema, conformando un pull de valiosos conocimientos empíricos de carácter cualitativo, el cual se ingresa en la base de datos del programa bajo la forma de "Observaciones de la marea".

Cabe aclarar que la pesquería de vieira patagónica fue la primera pesquería en superar exitosamente el proceso de Certificación en el país. Parte de este logro fue gracias a la información aportada por los Observadores.

Session 8. Observer training, safety and mental health

Leader: John La Fargue

Observers face many challenges and risks in the course of their duties. They must deal with cultural differences, stress, fatigue, isolation, unsafe vessels and sometimes even violence. Programs have the task of helping observers cope with these factors through support, training and the provision of technology/equipment. This session explored some of the issues faced by observers and how protocols, training and technology can help reduce the risks associated with observing.

Oral Presentations - Extended Abstracts

Are European observers programmes safe?

Lisa Borges

FishFix, Belgium

Introduction

Observers on board commercial fishing vessels are usually not specifically recognized when referring to fishers and fishing vessels crew. However, in the European Union (EU), as in many parts of the world, observers are a regular presence in fishing vessels. Observers collect scientific data while at sea, but in many jurisdictions observers have also an enforcement role, making sure that national and international regulations are not being breached. Observer's at-sea programmes are vital to the provision of scientific advice, enforcement of regulations and effective fisheries management.

In the EU, through the Data Collection Framework (DCF, Commission Regulation (EC) No. 665/2008), a framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy (CFP), Member States (MSs) have to develop at-sea monitoring programmes (usually based on human observers) and fishing vessels targeted by the programme have to accept the presence of the observer except in case of lack of space or for safety reasons. In the 23 EU MSs that have a sea border, the majority (20 MSs) have running at-sea observers programmes. In 2018, the remaining 3 MSs will start pilot observers programmes.

At-sea observers programmes in the EU are normally run by the national fisheries research institution, although observers and their training can be outsourced and subcontracted. While the data collected by these programmes is centralized and summarized at EU level, there is however no overview of the programmes operational specifications. There is also no common European or national standards for observers training on data collection or on health & safety, with training courses curriculum, duration and refresh requirements varying greatly between, and even within MSs. The requirements for at-sea observers gear and safety tools are also not standardized.

In this context, and to obtain an EU wide view of existent observers programmes, an online survey was carried out targeted at the DCF National Correspondents and/or the national observers programme managers. The survey is part of a wider study on “Training of Fishers”13 under funding from the European Parliament. Based on the survey participants replies, this paper provides for the first time the operational reality of at-sea observers programmes in Europe, its commonalities and differences, highlighting best practices and offering some recommendations.

Methods

An online survey was carried out targeted at the DCF National Correspondents14 (29 persons contacted) and known national observers programmes managers (17 persons) in order to provide a EU wide view of existent observers programmes, its requirements in terms of training and sea safety, and on its operation in the most recent year (2016). The survey consisted of four parts:

1. General information on observers programmes: how many observers programmes, name of the programmes, ICES area/fisheries, run by (private company, government agency, other), number of observers (male/female), duties of observers (at sea sampling, port sampling, electronic monitoring viewing, others), employment situation (independent, annual contracts, others), managers contact.
2. Information on training: training required and periodicity, training provided by (private company, government agency, others), training paid by (observer, government agency, private company), how long training (number of days), what modules includes (species ID, sampling techniques, data recording and reporting, sea safety, harassment/conflict resolution, others), material provided to observer (species ID books, manual, computer, gps, camera, binoculars, measuring boards, boots, oilskin, gloves, others).
3. Safety at sea: training required and periodicity, module provided by (private company, gov agency, other), training paid by (observer, government agency, private company), how long (number of days), what modules includes (first aid, firefighting, survival techniques, others), material provided to observer (life jacket, immersing suite, personal locater beacons – PLBs/Emergency Position Indicating Radio Beacon - EPIRB, others).
4. Operational information in 2016: total number of days at sea sampled, incidents reported (sexual harassment, intimidation/interference/threats, injuries, others), vessel

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13 Ackermann, R., Franceschelli, N., Sanz, M., Maridis, G., Kubenova, V., Pereau, E., van Dessel, B., Haasnoot,

T., Le Roy, Y. &. Borges, L. 2018, Research for PECH Committee – Training of Fishers, European Parliament, Policy Department for Structural and Cohesion Policies, Brussels http://www.europarl.europa.eu/RegData/etudes/STUD/2018/617484/IPOL_STU(2018)617484_EN.pdf

14 https://datacollection.jrc.ec.europa.eu/national-correspondent

refusal (no reason, safety, space, other), observer refusal (space, living conditions, safety, other).

Results

There were in total 24 replies to the survey from 12 MSs (Figure 1) from 14 observers programme coordinators (Portugal: continental Portugal and the Azores, Germany: Baltic Sea and North Sea). The data provided characterizes between 13 to more than 31 different observer programmes, depending if the different fisheries monitored under the same funding and/or institution are considered independent programmes or not.

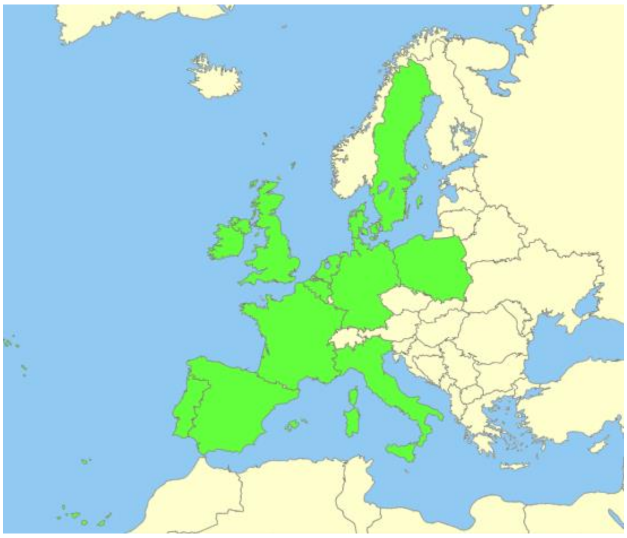

Figure 1 – European map with the eleven EU countries observers programmes replies highlighted (based on http://philarcher.org/diary/2013/euromap/)

The results of the observer programmes analysed, shows that the majority (77%) are run by government entities (majority by state own or funded research institutes, the rest by university fisheries departments), 15% programmes are run by private companies, and only 8% by the fishing industry.

The programmes analysed hire in total 215 observers, 65% of them men, with only three programmes (in south European countries) where female observers are the majority.

Not all programmes require training for observers/staff that carry out duties at sea, although the majority do have compulsory training requirements (92%). Sea safety is the most common training module required to observers, taking in average 3 days (between 1-5 days) to complete. The majority of sea safety training is given by private companies (80%) but paid by government agencies (70%). Most programmes include a first aid, firefighting and survival techniques modules in their training curriculum, while harassment & conflict resolution is offered in 30% of programmes.

Regarding safety material, most but not all programmes provide life-jackets (93%) and immersion suits (79%), while first-aid kits and Personal Locator Beacons (PLBs) are only required in 15% and 30% of programmes, respectively.

There has been little reporting of incidents by observers, with only 22% of programmes reporting any incident, divided between injuries (66%) and intimidation/interference/threats (34%). There were however several occurrences of observers being refused on-board vessels, due to limited space, for safety reasons or for no justification. However, observers are in many programmes entitled to choose the vessels they board due to the same reasons of safety, space and living conditions, so the results may not necessarily reflect the reality in all programmes. Some programmes are nevertheless moving to a mandatory system where, when a vessel is assessed to be suitable, refusal to carry an observer may result in a penalty.

Conclusions

So are European observers programmes safe? Yes, but not all: at least *two programmes have no compulsory training and a further two that have no safety training*. There are additional programmes that only follow the minimum training requirements for fishing crew or for sea cruises personal, with other MSs programmes provide observers only a description of the vessel safety features. Even within MSs, different observer programmes have distinct requirements regarding safety training.

The requirements for at-sea observers gear and safety tools are also not standardised, with some programmes providing basic fishing gear (oil skins, boots and gloves) to other programmes adding specific safety gear such as immersions suits, automatic life vests and emergency locator beacons, among others.

There is therefore a need for a common European standard for the safety training and certification of observers[i], but also for a common approach and methodology to ensure effective implementation of any standard across the EU. This should cover not only initial training and certification, but also requirements for periodic retraining and recertification. These measures should enhance European programmes safety, while activities to raise safety awareness should be promoted.

#MeTooAtSea, Preventing and Responding to Sexual Harassment

Sara Hutton

IAP World Services (as of 6/21/18 Riverside Technologies, Inc.)
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Sexual harassment has been common across workplaces, and only recently has reached the national stage. For observers, harassment of any form continues to be a constant occupational hazard that must be prevented to ensure safety and the collection of high quality data. The different physical and social conditions at sea versus land can exacerbate and escalate incidents of sexual harassment and require observers to recognize and respond immediately. While sexual harassment affects all observers, females do face specific challenges on male dominated boats. Unlike office jobs where employees can remove themselves from an uncomfortable situation and go to HR for help, observers have to directly confront their harasser and try to stop the behavior. What resources are available to help observers prevent harassment and protect them when it occurs?

Defining what qualifies as sexual harassment can vary from person to person, but the common feature is that the harasser's conduct is unwelcome. It includes sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature that explicitly or implicitly affects an individual's employment, unreasonably interferes with an individual's work performance, or creates an intimidating, hostile, or offensive work environment. Sexual assault refers to sexual contact or behavior that occurs without explicit consent of the victim. For the sake of safety, observers should err on the side of reporting any behavior that may make them or others uncomfortable. It is illegal to sexually harass or assault an observer under the Magnuson Act and Marine Mammal Protection Act and violators are subject to civil and/or criminal penalties. Yet, cases of sexual harassment and assault of observers are reported each year, and there are more that go unreported. Viewing the #MeToo movement in the context of fisheries observing, we can draw attention to these continuing problems and promote prevention, reporting, and response.

I will explore five important questions around sexual harassment of fisheries observers, focusing on the US National Marine Fisheries Service (NMFS) Southeast Reef and Shrimp Observer Program, with the goal of encouraging all employees involved in training and response to clearly know their roles and seek improvement at all steps: (1) What are observer rights and responsibilities?, (2) How do programs prepare observers for dealing with these conflicts?, (3) What is the the reporting process for sexual harassment to assault?, (4) How do employers and government agencies respond if problems on board are reported?, and (5) Are these policies clearly know by all parties and is their feedback encouraged?

Observer employer and vessel/plant owners and operators have the regulatory responsibility to protect observers and their data, yet fishermen are not employees of theirs. In practice it is often up to NOAA NMFS to promote a safe and harassment-free work environment. They are responsible for training observers, providing resources and support, and coordinating response, while observers are responsible for recognising and reporting sexual harassment assault.

Standard office-place sexual harassment training is inadequate for conditions at sea. Training manual guidance told female observers to be proactive in altering their own behavior to prevent sexual harassment. If harassment still occurred, observers were told to be simultaneously assertive, professional and diplomatic in telling the offender to stop their behavior. If it didn't stop, the issue was brought to the captain, and the last resort is reporting to a supervisor. Any of these actions by an observer can have ramifications on board and on future boats, which are highly dependent on the situation, personalities, and captain and crew dynamic. Now we recognize that even harassment that is halted by an observer should be reported by phone to a coordinator or supervisor, but observers must know possible outcomes to feel confident enough to do so. Training involves discussions for halting or de-escalating sexual harassment from experienced observers based on real situations, and ideally a representatives from Office of Law Enforcement (OLE) should be involved to talk about their role in reporting and response.

While deployed at sea, communication equipment independent of those used by boat, such as a satellite phone, are essential for reporting. Regular check-ins with status codes can keep support staff informed of any possible incidences. However, observers don't always have privacy or conditions conducive to clear communication, making a personal EPIRB or PLB an important back-up if they need to escape a bad situation. Response is situational, though the thought process of observers facing harassment can seem like a game of "would you rather" with no good outcome; sticking it out and ignoring the avoiding the offender can be perceived as easier than reporting and facing possible loss of income, conflict, hassle, and tarnished reputation. Knowing support exists and will be followed through on is essential to encouraging observers to report these incidences. Any harassment, even if it has been dealt with by the observer, should be reported by satellite phone to the coordinators in the Galveston office. Observers should keep real-time records in their log books as they may be useful in later investigations. They need to know that they won't be sent back to that same dock, will not be faulted for refusing any trip that makes them feel unsafe or uncomfortable, and will be given another trip soon to mitigate lost wages.

Once an incident is reported, coordinators will consult with OLE and most likely increase call-in frequency to monitor the situation. OLE may make the decision to bring the boat in even or rescue if the observer thinks they are safe. If an observer needs to be taken off a boat, it will be pulled in or a US Coast Guard cutter will there as quickly as possible. Charges and reprimands for the harasser range from verbal warnings to fines and prison, and are the responsibility of OLE, who may involve USCG and FBI in investigations. OLE is also responsible for keeping track of reported incidents by region, but public information is limited and not nationally or internationally standardized. Incidences are often associated with vessels, rather than the offender, who may work in different regions on various vessels. What happens to the harasser needs to be communicated to the observer who reported it, and further support such as counselling should be offered as part of that follow-up.

Re-examining existing sexual harassment policies and protocols reveals room for improvement in each role and step along the way. Observer programs must provide support in training and resources so observers can report harassment confidently, knowing they will have support through a timely and fair response. Encouraging and soliciting feedback from observers about improving and increasing support is an important step that NOAA staff and affiliates have begun working on. Training of both new hires and returning observers should involve seasoned observers and other involved agencies, encourage role playing and questions, and clearly divulge possible outcomes of reporting. Essential resources that may be lacking in some programs include adequate information provided to captain and crew prior to boarding to take some responsibility off observers, and independent communication devices for reporting concerns. Reported incidences should be recorded and associated with the offender as well as the vessel, standardized, and publicly accessible. Most essential to addressing harassment is communication; everyone involved needs to be clear in their roles and responsibilities and programs and observers should be kept in the loop of further responses to incidents and any policy or protocol changes.

I invite observers and observer program coordinators to review their sexual harassment training and procedures to ensure all actors know their roles and responsibilities and to find ways to better prevent and respond to these all-too-common instances. I know my own experience and have learned more about my program, but I have still unanswered questions. Several IFOMC attendees have drawn attention to sexual harassment and assault of observer at sea, but these issues warrant national and global review. National guidelines and protocols from training to reporting to record keeping is the outcome we can work toward together.

The potential impacts of work-related stress on North Pacific Observers

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There is no question that fisheries observers can be subject to difficult working conditions, which can prove to be unfavorable, stressful, and sometimes hostile. This includes but is not limited to exposure to harsh weather conditions, isolation, compromises to living conditions, and conflict with crewmembers (e.g., intimidation, coercion, harassment). The exposure to intense, chronic work-related stress (defined as emotional, cognitive, behavioral, and physiological reactions to aversive and noxious aspects of one's work, the work environment, and work organization) can have substantial costs to a person, community, and enterprise costing U.S. businesses anywhere from $221.13 million to $187 billion in total (Hassard *et al.* 2018). Yet, the consequences of work-related stress for fisheries observers remain largely unexplored. Currently, the North Pacific observer training program and manual do not address mental health impacts or coping mechanisms for work-related stress. Training and briefing programs do, however, discuss victim crimes and how to report them, observer rights, and resources available for victims of harassment and assault.

Several questions exist surrounding the issue of work related stress for fisheries observers. 1) Is there evidence to suggest that work-related stress (WRS) could impact observers and, if so, (2) is it the intense chronic type that has significant impacts on job satisfaction and well-being? (3) Even further, should the observer program and providers employing these individuals care about the potential impacts of WRS and – resultantly – (4) invest in additional services to alleviate the consequences? While these questions are not fully explored, my goal is to initiate the conversation on observer mental health and represent the North Pacific observer voice on perceived issues with mental health support. To begin to answer these questions, I evaluated personal experiences in the North Pacific observer program to identify areas of work-related stress and define mental health concerns. I also explored the scientific literature to distinguish mental health issues and impacts of WRS in the fishing industry comparing it with fisheries observing in order to further understand how aspects of this position could impact mental health, job satisfaction, and well-being. In general, this project serves as an opportunity to explore the current state of mental health concerns and awareness in the North Pacific observer program as well as draw on patterns of work-related stress in the fishing industry to consider the state of mental health of observers globally. Identifying mental health concerns and sources of stress for observers could help develop life-saving resources and training for the program as well as increase awareness and reduce mental health impacts of this unique, but sometimes challenging, position.

Not only information on North Pacific observer mental health is lacking, data on Alaskan fishermen is also relatively limited. However, there is evidence suggesting that people working in the fishing industry as a whole experience work-related stress and suffer from elevated mental health impacts compared to other professions. A study evaluating the physical and mental health status of various occupations in Norway found that agricultural, forestry, and fisheries workers scored lowest on mental health compared to all other professions (Riise, Moen, Nortvedt, 2003). Even further, this group of occupations shows an excess risk and higher rates of suicide (Klingelschmidt *et al*., 2016). The authors discussed several possible explanations including long working hours, social isolation, physically demanding work, and high levels of occupational stress due to unpredictable natural events and working conditions. The exposure to these stressors is likely similar for fisheries observers, but work-related stressors in the fishing industry and amongst observers remain largely unexplored making it difficult to define and predict their consequences.

One study by Johnson and others (1994) compared the degree of exposure to occupational stressors, social support, and the presence of non-clinical depression and somatization between US Gulf Coast shrimp fishermen and land-based workers. In general, fishermen experienced greater levels of WRS exposure. The study used surveys, which included questions regarding how much that individual worries about certain stressors (e.g., workload, safety, cleanliness, conflict; defined by the World Health Organization) using a five-point Likert scale. From this survey, migration and safety, overload, responsibility for other's lives and income, as well as a lack of career development [with age as a covariate (p = 0.06)] were significant stressors for shrimp fishermen. Moreover, these fishermen worried about things at home, worked more than twelve hours a day, felt pressure for their crewmembers' livelihoods and safety, and worried about learning skills that could be used in five years time.

Using a similar approach, I surveyed a small subset (n = 23) of North Pacific observers to determine potential stressors in this program. Overall, 26.1% strongly agreed and 39.1% agreed that observing is a stressful job. Migration, overload, lack of career development opportunities, control over work conditions, and conflict seem to be potential stressors with serious impacts and/or lack observer program training and support (see Table 1). A majority of the observers surveyed worked with the same observer provider and did not include representation from other companies. Additionally, most of the observers received certification in the past five years meaning these responses lack any long-term perspectives. Further evaluation that includes a breadth of observer experiences as well as potential covariates is necessary to identify which stressors impact observers and would facilitate development of appropriate resources to remedy WRS.

In addition to conducting surveys to evaluate WRS, job satisfaction can be used as a substitute measure that includes components of WRS, well-being, and employee performance. In an independent review of the North Pacific Observer (NPO) program conducted by MRAG Americas, Inc. (2000), observers expressed low job satisfaction accompanied by high turnover rates with approximately 45% of observers completing only a single cruise. Employee turnover is often a sign of poor working conditions, low job satisfaction, high exposure to WRS, or a lack of employee support. As a result of this review, the NPO program developed the observer cadre, which aimed at improving communication between the observer program and observers in order to enhance support. Since then, North Pacific observers have had access to in-season advisors via ATLAS (data management and communication software) and field offices in Anchorage, Kodiak and Dutch Harbor, Alaska. However, much of this interaction and communication is focused on sampling procedures and data quality assurance and observers do not feel comfortable communicating personal experiences and concerns.

It is possible that observer retention has improved from rates determined in 2000; however, it appears relatively high turnover in the NPO program still exists (Figure 1). Approximately 50.6% of NP observers received certification since 2016 and 66.5% since 2015 suggesting that most observers only spend two to three years working for the program (mean = 3.64 years; however, data is highly skewed, see Figure 1). These data include observers who are currently certified. In the NPO program, certification expires after 18 months. If we eliminated observers that are still certified, but have not completed a cruise within this time frame, we would likely discover even lower rates of retention. These high rates of turnover suggest that there are still some aspects of this program that are unfavorable. Additional work must be done to try and understand what is driving observers to leave the program. There is an understanding that this job is inherently difficult and that the observer program and/or providers cannot improve certain components. Yet, observers universally agree that both groups can do more to address work-related stress (Table 1).

Understanding what factors drive WRS, lower job satisfaction, and impact well-being in the NPO program will help us to understand the costs of observing on a global scale. Within the fishing industry, there is evidence to suggest that the fishery, vessel, and gear type are important factors in employee performance and mental health amongst fishermen (Smith & Clay, 2010; Pollnac *et al*., 2015). For example, Binkley (1995) found that, amongst fishermen in Nova Scotia, mid-shore fishermen experienced higher levels of job satisfaction than those working on trawlers, which is likely due to shorter times at sea and fishing closer to home. In addition to sea time, workload and control over one's working conditions could be important predictors of well-being in the fishing industry (Pollnac & Poggie, 2006; Remmen *et al*., 2017). In the NPO program, both full and partial coverage observers commit to 90-day contracts with most observers completing on average a 60-day cruise. There can be substantial variation in the amount of sea time observed during these cruises, which is determined by the vessel and gear type that the observer is assigned. The average trip length for pelagic trawl catcher vessels is 1.95 days whereas catcher processors have an average trip length of 12.00 days. In comparison, catcher processors that longline can spend on average 21.64 days at sea. This variability in sea time and workload means that observers could experience drastic differences in stress and, therefore, vessel/gear type should be considered if additional services are developed.

What remains unclear is whether observers are subject to intense, chronic work-related stress; high rates of turnover suggest that job satisfaction is low with possible high levels of stress. Developing services to help ease the challenges of this position may be difficult because several different groups are involved in providing observer support. Although these groups can take on distinct responsibilities in employing and supporting observers, working together to alleviate work-related stress will likely reduce costs and enhance investments that go into employing, certifying, and supporting observers over time. As a representative from this group, I am concerned with the potential long-term costs of WRS to observers that likely occur after contract when health insurance and services are difficult to obtain with the current United States healthcare system. Overall, addressing work-related stress will reduce costs at multiple levels and especially for observers, providers, and the observer program, improve employee performance further enhancing data quality, and establish stronger relationships between the observer program and the fishing industry.

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Table 1. Percent response of North Pacific Groundfish observer to work-related stress survey questions based on a five-point Likert scale (1: Always, Strongly Agree, Very Likely; 2: Fairly Often, Agree, Likely; 3: Sometimes, Neither Agree nor Disagree, Neither Likely nor Unlikely; 4: Rarely, Disagree, Unlikely; 5: Never, Strongly Disagree, Very Unlikely)

Survey Questions:	1	2	3	4	5
Observing is a stressful job.	26.1	39.1	21.7	13	0
The observer program should do more to address work-related stress.	21.7	52.2	21.7	4.3	0
My provider should do more to address work-related stress.	21.7	52.2	17.4	8.7	0
Migration/Safety					
How often do you worry about things at home while on contract?	26.1	30.4	39.1	4.3	0
How often do you work nights and sleep days?	17.4	52.2	26.1	4.3	0
How often do you worry about being hurt on the job?	0	26.1	56.4	13	4.3
How often do you experience problems with weather while on contract?	8.7	60.9	30.4	0	0
How often do you experience problems with noise while on contract?	30.4	30.4	21.7	17.4	0
How often are you concerned with safety of your work environment?	17.4	21.7	56.5	4.3	0
Overload					
How often do you work more than 12 hours a day?	4.3	34.8	39.1	21.7	0
How often do you work when not fully rested?	4.3	43.5	39.1	13	0
How often are you prevented by work from getting sleep?	4.3	21.7	52.2	17.4	4.3
Career development					
How often do you feel challenged in your job?	0	0	87	13	0
How often do you feel like you are learning skills to get ahead from your job?	0	13	56.5	30.4	0
How often do you feel you do what you do best?	8.7	26.1	43.5	21.7	0
Control					
How often do you feel like you make your own decisions as an observer?	8.7	26.1	39.1	21.7	4.3
How likely is your provider to listen to your comments about your experience working as an observer?	4.3	4.3	31.8	50	9.1
How likely is NMFS to listen to your comments about your experience working as an observer?	8.7	52.2	21.7	13	4.3
Conflict					
How often do you worry about conflict with others in your work environment?	0	30.4	43.5	26.1	0
Responsibility for other's lives/income					
How often do you feel responsible for others' lives while on contract?	4.3	4.3	34.8	52.2	4.3
How often do you feel responsible for others' income?	4.3	4.3	13	47.8	30.4
Underload					
How often do you find yourself with little work to do?	0	17.4	56.5	21.7	4.3
Workpace					
How often do you have more work than you can handle?	0	4.3	56.5	39.1	0
How often do you find your job dull or monotonous?	21.7	43.5	30.4	4.3	0
Cleanliness					
How often do you worry about the cleanliness of you work environment?	13	39.1	34.8	13	0
How often do you worry about the living conditions on your vessel?	13	39.1	30.4	13	4.3

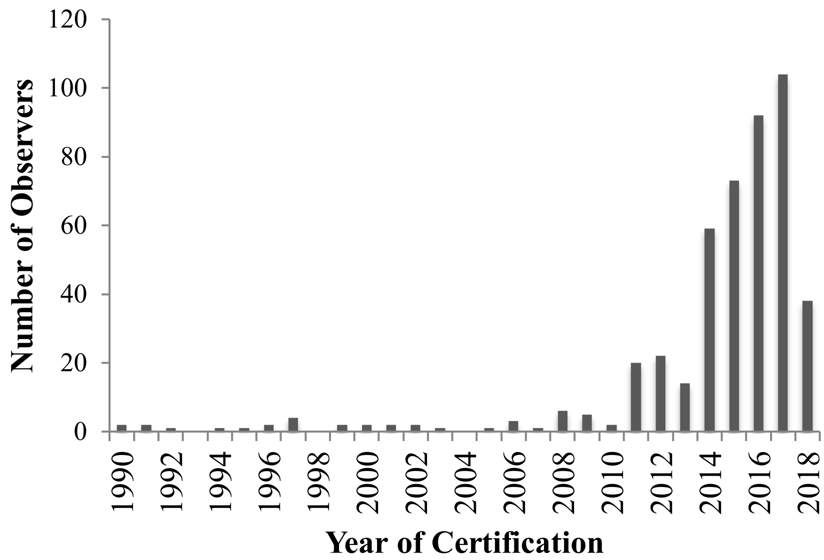

Figure 1. Number of observers certified by year (n = 462) for the North Pacific Groundfish Observer Program (full and partial coverage). Does not take into account which month observer was certified.

Assessing Risk in a Risky Business: A New Tool for Observer Program Managers

Teresa Turk

Teresa Turk Enterprises, USA

<u>Background</u>

In 2016 fishing was ranked as the 2nd deadliest occupation in the United States and internationally, fishing is consistently in the top three of most deadly jobs (Figure 115). Fisheries observers are exposed to similar risk as fishers as illustrated by the recent loss of two US citizen observers in 2015 and the loss of an observer on a US flagged vessel in the Western Central Pacific in 2016. Globally, at a minimum 1716,17observers have been killed in accidents and others have "disappeared" since observer programs began in the 1970's. The number of deaths is likely severely under reported because government institutions and observer service providers are not required to track or report these deaths or injuries to any international institution, such as the International Maritime Organization (IMO).

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15 https://www.bls.gov/news.release/pdf/cfoi.pdf

16 Association of Professional Observers, http://www.apo-observers.org/misses, last reviewed 6/4/18

17 http://www.allotsego.com/alexander-johannesen-wildlife-biologist-30-dies-while-working-in-alaska-fisheries

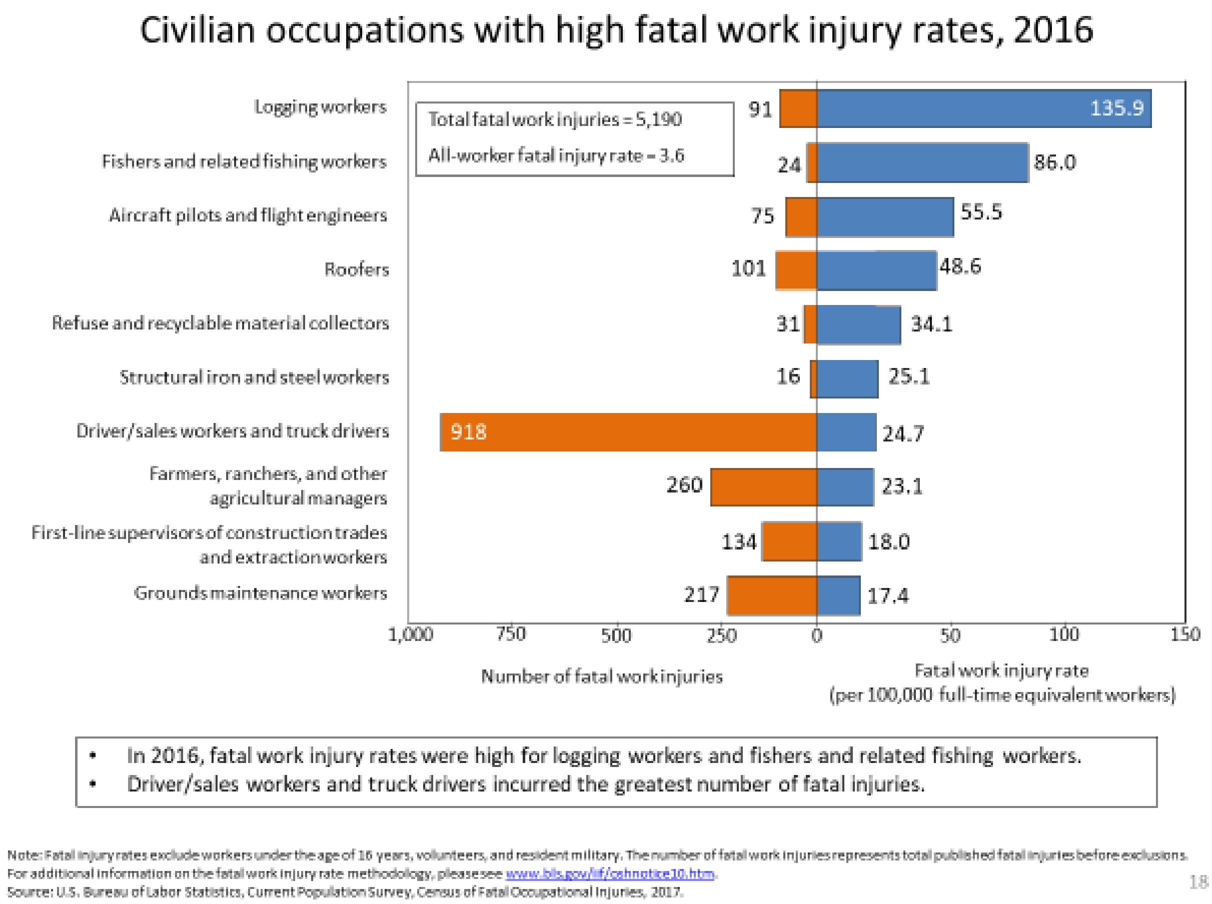

Figure 1. United States Civilian Occupations with high fatal work injury rates, 2016.

Although standardized information on the types and rates of injury do not exist for the US observer programs, the number of observer days at sea (DAS) and the number of observers employed are available. From 2007-2016, each year an average 872 US observers collected data from 75,377 DAS on board commercial fishing vessels.

During 2016, 995 observers collected data during 79,201 DAS with one fatality, Josh Sheldon. Using the US Bureau of Labor Statistics to calculate the fatality rate18 with the limited observer employment data available, the loss of Josh Sheldon's life represents 100.50 fatality rate, greater than the rate reported for fishing (86.0) in 2016. Using the total number of observers working at sea (8718) from 2007-2016 and the total number of observer fatalities (3) during the same time period, the observer fatality rate is 34.41, less than the fishing mortality rate 86.0 for 2016 and significantly less than the average fishing mortality rate of 114.03 from 2007-2016. The fisheries observer fatality rate should be significantly lower than those of overall fishers because observers are generally deployed on larger vessels, have conducted a pre-trip vessel safety checklist, have received safety training, and are deployed on vessels that have a current USCG safety decal signifying a vessel inspection within the past two years.

Tool Development

18 https://www.bls.gov/bls/glossary.htm#F

During the past 30 years, the United States and several other countries have increased observer safety training requirements including hands on demonstrations and testing, required the successful completion of a pre-trip vessel safety checklist, and mandatory use of a PFD on deck. These measures have contributed to at least 20 observers surviving the sinking of vessels at sea[19] and likely reduced the observer mortality rate.

Are there other characteristics of a fishery, the vessel or the observer themselves that add to risk of an injury, fatality or disappearance at sea? Are there simply some fisheries where observers should not be deployed? Or at least not deployed until many of the serious risk factors are addressed or reduced? Should medical and physical requirements be increased for observers?

Much like NOAA's attempt to identify risk factors in designing fisheries management programs[20], observer programs should consider uncovering risk factors prior to deploying observers in a new fishery, or a fishery that has experienced significant changes such as the size and maintenance of the vessel, location of fishery, or the availability of emergency rescue services. Observer program managers should consider informing decision makers of the high risk associated with gathering information by fisheries observers. The bottom line- Is the data more important than placing an observer in an extremely dangerous situation?

Methods

The development of a flexible and objective tool to assess risk for an individual observer, fishing vessel or fishery in combination or separately may prove valuable to observer program managers. The risk assessment tool uses 23 different parameters to assign points based on the various risk factors, such as distance from shore, size of vessel, health of the observer, and independent communication options.

The tool was tested on two recent incidents (Keith Davis and Usaia Masibalavu) on vessels far offshore, out of USCG or national emergency response areas. The tool was also tested using Josh Sheldon information and one other "typical" observers operating in US waters using US observer standards and procedures.

A score over 20 points indicates a high-risk environment for the observer and should trigger review by a program manager on ways to reduce the risk to an observer.

Results and Discussion

The tool identified the observers on offshore vessels as being in high risk environments (Davis and Masibalavu). In both cases, the tool noted high values that indicated a high-risk environment for the observer (Table 1). Neither of the US examples (Sheldon or typical observer) appeared to have met the high-risk threshold of 20 points. With additional data, the risk assessment tool can be refined and tuned for future use recognizing (and hopefully mitigating) high risk environments.

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19 Ibid, 1.

20 https://www.fisheries.noaa.gov/resource/research/guidance-fishing-vessel-risk-assessments-and-accounting-safety-sea-fishery

During the past 40 years fishing vessel safety has improved significantly as has observer safety training and the implementation of other protocols to reduce risk. However, observer program managers and decision makers need to remain vigilant in continuing to reduce observer work related injuries and fatalities by exploring new technologies and implementing risk assessment tools followed by action.

Table 1. Risk Assessment Results for Keith Davis, Usaia Masibalavu and two US observers.

Risk Factors		**Davis**	**Masibalavu**	**Sheldon**	**Typical**
Vessel Risk Factors	**Criteria**				
Length	LOA >100'=0, 75-100'=1, 60'-75'=2, <60'=3	0	0	1	2
Distance offshore	0-50=0, 51-100=1, 100-200=2, >200=3	3	3	1	1
Previous fines/enforcement issues	1=1, 2=2, >3=3	0	0	0	0
Fishery risk factor from other studies	Use if information on fleet fatalities is available	0	0	0	0
Different nationality than observer	Different=1, Different and problems communicating=2	2	1	2	0
USCG or national jurisdiction	Outside USCG or national jurisdiction=3	3	3	0	0
Vessel Risk Total Score		**8**	**7**	**4**	**3**
Observer Risk Factors	**Criteria**				
Experience at sea (days at sea)	500+=0, 301-500=1, 101-300=2, 0-100=3	0	1	0	1
Recent class safety training	Less than 1 year=0, 1-2 years=1, 2-3 years=2, >3 years=3	2	3	1	0
In water AMSEA training	Less than a year=0, 1-2 years=1, 2-3 years=2, >3 years=3	2	3	1	0
Wilderness first aid	Less than 1 year=0, 1-2 years=1, 2-3 years=2, >3 years=3	2	3	1	0
Observer medical history	No health issues=0, Bone/muscle prob=1, chronic but not serious if untreated=2, serious if untreated=3	0	3	0	3
Observer mental history including drug abuse	No DUI or mental issues=0, DUI=1, Mental health problems=2, DUI + Mental health issues=3	0	0	0	0
Age	21-40=0, 41-50=1, 51-60=2, 61+=3	1	1	1	0
Observer Risk Total Score		**7**	**14**	**4**	**4**
Procedural Risk	**Criteria**				
At Sea Transfers	No=0, Yes=3	3	3	0	0
Compliance Duties	No=0, Yes=3	3	3	3	3
Vessel Safety checklist review	Yes=0, Partial=1, No=3	1	1	0	0
Vessel Inspections (Has a current safety sticker)	Yes=0, No=3	3	3	0	0
Independent Communication	Yes=0, No=3	3	3	0	0
Check In frequency	>3 days=1, 4-6 days=2, > 6 days=3	2	2	3	2
Required to wear PFD	Yes=0, No=3	0	0	0	0
Issued independent PLB, Personal EPIRB	Yes=0, No=3	3	3	0	0
Placement/orientation meeting	Yes=0, Partial=1, No=3	1	1	1	1

Risk Factors		Davis	Masibalavu	Sheldon	Typical
Only observer on board from single authority	Yes=0, No=1	1	1	1	1
Procedural Risk Total Score		**19**	**19**	**8**	**7**
Combined Score for all factors		**34**	**40**	**16**	**14**

Making the Case for a Global Record of Observer Incidents.

Bubba Cook, J.D.

World Wide Fund for Nature (WWF)

Introduction

Since 2010, there have been at least eight observer fatalities recorded internationally. In each of those cases, national and regional authorities made very little, if any, information available to other jurisdictions. However, fisheries are a global enterprise where vessels and personnel operate across broad ocean areas and multiple jurisdictions where they are subject to carrying observers under various regulatory arrangements. Therefore, what happens in one ocean can have a clear and direct impact in another with respect to observer safety and security. WWF contends that there is a need to address these issues with a global approach in order to ensure the safety and security of observers across the fisheries in which they serve.

Framing the Problem

The problem may be represented through three primary conditions that exist including: (1) Fisheries observers are subject to discrete hazards onboard the vessels on which they serve; (2) Fisheries observers are deployed on vessels that go far out to sea and that might fish in multiple jurisdictions; and (3) An infraction against an observer in one jurisdiction is not recorded in such a way that it will be available or evident to an authority in another jurisdiction.

With respect to the first condition, in addition to the general shipboard hazards faced by all seafarers, it is broadly recognized and supported by evidence that fisheries observers are subject to harassment, intimidation, threats, assault, and even death. In relation to the second condition, over a five-year period from 2012 to 2016, Global Fishing Watch conducted an analysis that indicated that fishing vessels engaged in 40 million hours of fishing activity and covered a combined track length of 460 million km that extended over at least 55 percent of the ocean and multiple national, regional, and international jurisdictions. This analysis determined that fishing is conducted primarily by five flag states – China, Spain, Taiwan, Japan and South Korea – which accounted for over 85 percent of observed fishing effort. These vessels are often licensed and fish across multiple jurisdictions globally. However, regarding the third condition, despite the availability of state of the art information sharing technologies that allow access to information across the globe instantaneously there is currently no system to facilitate information sharing regarding infractions against observers.

As a result, when an observer is threatened, intimidated, harassed, assaulted, or even killed on a vessel, which should imbue a higher risk of a subsequent observer placement with that vessel and associated crew, responsible authorities currently have no way of identifying and tracking that vessel or crew. Therefore, observer authorities could be continually, unwittingly, and unnecessarily, putting observers at risk.

The Existing Regulatory and Policy Environment

The current state of the regulatory environment with respect to global fishing contributes to the challenges observers face. Various recordkeeping and reporting obligations exist at the national, regional, or international level applicable to observers, but those obligations are often siloed and fail to extend beyond or inform other applicable jurisdictions. This system failure is evidenced by the fact that despite the death and injury of numerous observers under a variety of circumstances in recent years, it is difficult, if not impossible, to determine any trends or even fully account for infringements against those observers. This deficiency is driven, in part, by the fact that a competent regional or international authority is not collectively responsible or authoritatively charged with recording the details surrounding those incidents.

Additionally, while incidents against observers might be recorded locally within a national or sub-regional jurisdiction, they are rarely shared outside that immediate jurisdiction, whether through official channels or, much less, in the public domain. Discrete information about observer incidents is sometimes not even fully recorded and maintained at the national level and what is recorded is often not shared with regional or international authorities. This issue is compounded by the fact that types of information and formats can vary among jurisdictions as to what information should be collected and for what purpose, creating broad inconsistencies among regions. This incongruity in data collection emphasizes the need for a standardized format or, at minimum, standard elements for documenting infringements against observers.

Precedent of Global Coordinating Mechanisms

Several examples exist where international institutions have created mechanisms to address similar issues on a global scale. The Global Record of Fishing Vessels (GRFV), which is a phased and collaborative global initiative to make available, in a rapid way, certified data from State authorities about vessels and vessel-related activities represents an example of a global collaborative information collection and sharing mechanism. The GRFV program aims to provide a single access point for information on vessels used for fishing and fishing-related activities with a primary objective to combat illegal, unreported and unregulated (IUU) fishing by enhancing transparency and traceability. However, while the GRFV and various IUU Vessel Blacklists designed to operate in a similar way are useful examples of cross-jurisdictional and transboundary legal mechanisms for addressing or preventing criminal activities, the reality is that *vessels* do not commit crimes, but, rather, *people* do.

The Person of Interest (POI) standard represents one of the first regional attempts to address people engaged in fisheries crime in a systematic way. The POI standard currently under development by the Pacific Islands Forum Fisheries Agency (FFA) extends from the recognition that information on persons involved in illegal fishing are not being systematically collected, analysed, shared or used to address illegal fishing. The POI initiative maintains a primary objective to profile natural persons and companies involved in IUU fishing, including infringements against observers, specifically in the collection, sharing, and use of such information. This information could then be used to, for instance, determine risk-based placement of observers, identify and recommend additional safety measures if necessary, refuse observer placement on a vessel, or even refuse licensing of a vessel. The FFA has already determined a sound legal basis to collect, share and use POI data and is now in the process of developing further policy and criteria for implementation of the standard.

The European Union is currently leading an effort to implement a data standardization process designed to streamline integration of fisheries data in a more comprehensive and effective way. The FLUX Transportation Layer (FLUX TL) is an information integration system developed to help authorities exchange fisheries control information among themselves in implementing fisheries control measures. FLUX TL uses a new standard that has become the format to exchange electronic fisheries information and data among various fisheries authorities. There is also an associated protocol designed to exchange information effectively without human intervention using state-of-the-art machine learning technologies to guarantee interoperability. Essentially, FLUX TL creates a common language that should facilitate communication among all fisheries information systems and ease data sharing across all platforms.

These initiatives represent the foundation that could make a Global Record of Observer Incidents (GROI) not only possible, but also realistically achievable.

Conclusion

Given the number of recent incidents involving observer injury or death internationally, there is a clear and urgent need to better address observer safety and security. If observers are as important as we insist they are, then we owe it to them to create the infrastructure necessary to ensure their protection on a global scale. In many cases, they are the only source of independently verified catch information and, as a result, a critical piece of our ability to understand our collective marine heritage as well as address IUU effectively across jurisdictions.

There is technically and legally sound precedent for information sharing mechanisms such as that proposed here at the national, regional, and international levels. Moreover, a mechanism such as the GROI would complement and support broader initiatives to combat IUU fishing globally. Because responsible authorities currently cannot assess the information and circumstances associated with these incidents in a collective and comprehensive way, we cannot fully realize solutions to address these incidents at the appropriate scale, leaving observers subject to additional unnecessary risk. Therefore, this proposal calls for a standardized format for collection, compilation, and delivery of information related to observer incidents to be subsequently delivered to a competent international authority that will form a GROI as a necessary and appropriate step to help identify trends, assess relationships, and ascertain risks among observer programs in a way that observer safety and security may be increased on a global scale reflective of our global fisheries.

Recommendations for Moving Forward

Ongoing infractions against observers internationally suggest that the status quo is not an option. Unfortunately, at this time the only concerted effort to compile and collate observer incidents globally has been through the efforts of a tiny NGO, the Association for Professional Observers (APO), which with minimal staff and funding must rely on anecdotal or publically available information because it has neither remit nor access to official information. Thus, a more organized official approach must be engaged to genuinely address the collection and analysis of information about observer safety and security infringements on an international scale.

From a technical, administrative, and legal perspective, it is possible to create a new GROI from whole cloth and place it in a competent authority, but it might not be the most efficient or effective method. It could be possible to "bootstrap" the GROI into the GRFV or at least maintain it alongside that process and system. Additionally, a collaborative initiative between the United Nations Food and Agriculture Organization (FAO) and International Labor Organization (ILO) that also incorporates crew labor and human rights elements in addition to observer incidents could present a reasonable path forward.

Other suggestions include engaging Interpol or the International Monitoring, Control, and Surveillance (IMCS) Network to collect and collate information when observer incidents occur. However, as a matter of priority and focus neither of those institutions would likely be appropriate. Lastly, placing responsibility to maintain the GROI with a single national authority such as the US National Oceanic and Atmospheric Administration (NOAA) Fisheries Service could represent a prudent initial step to address the problem. Regardless of the ultimate path forward, one thing is clear and that is that action must be taken to ensure the safety and security of observers on a global scale.

Open Discussion Session

Q- Asked about how to create a global record of incidents.
A-some of the challenges and how there is no standardization in data collection on incidents. Better info sharing is key. Must have a broad level of transparency to address these issues. There needs to be some standardization of the process.

Q- Asked about unreported harassment and what avenues for reporting are being provided to observers.
A- *I was unsure about how to report as an observer and how the reporting process would flow. She asks for both written and real time reporting availability (Satellite). She recommends online reporting and tracking of what is being done to address the incident. Knowing what to do as an observer is important.*

Q- Would love to hear more from attendees about international observer safety issues and how observer safety can be advanced. Would love to hear what the number one issue might be and would love to hear about the issues that are most important.
A-Independent communication devices are high on the list.

A-I agree the communication system is huge. She discussed ATLAS in AK and that the lead observer handles the communication and the seconds don't have access or opportunities to communicate or may be unaware of how to communicate.
A-A few are holding up the process as it requires consensus. Communication ability is huge and it's a No brainer to get the devices.
A-discussed the need for clear jurisdictions and reporting protocols/systems.

Q- Was insurance looked at in the EU survey?
A- No insurance was not looked at in the EU training survey. On the insurance- a lot of programs observers may not be covered since they do not have safety training and observers are not on the crew list.
A - Comment-There are cultural differences with regards to sexual harassment. She has never felt harassed and maybe others do because of different tolerances.
A-I received feedback form other countries and some areas do not deploy woman. The US struggles with harassment issues maybe more than other countries.

Q- I like the risk assessment tool. Is it going to be available for observers to use as a risk assessment prior to becoming an observer or making a trip?
A-It is available but that use was not considered it while creating the assessment tool.
A-Observer stated she receives only a few details about the vessel (captain, name, size, location) she relies on other observers for additional information about the atmosphere on the vessel and feels a risk assessment tool could help her.
Comment -Observer states that there is inherent risk and as she continues to observer there is a complacency with observers who have been around for a while may not really be affected by a high risk score.
A- She was thinking of using the tool as a manager and less as an observer. Two recent casualties were run through the tool and it did tease one out as a high risk trip while the other was not identified as high risk. The tool could probably be fine-tuned.

Q-I have been diagnosed with mental illness and receive treatment for it. Not all that are mentally ill do get treatment. Using history of mental illness as a risk factor can be problematic. Those receiving treatment may be more capable at dealing with their condition than those who are not identified as having mental illness and seeking treatment. She cautions using this as a negative factor for those who are treating their illness.
A-I'm open to this and included this only because of the number of suicides by observers.
Comment- Programs should utilize therapist/medical professionals to test and see where observers are at mentally.

Q-Observer brought up risks of transport to vessels should be considered. Also if observers had a higher risks rating maybe they could be provided additional care by the provider. What about crew talk and how the nature of talk on vessels can be "Dirty". He is even affected by it and is there a difference for woman (hopefully yes). He also asked about observers harassing other observers in other programs. He hasn't noticed much of it. What is done about this?
A -Observer responded that they put up with a lot and if it is not directed at her she just tolerates it. Some crew change their behavior others don't. Reports are too general and about a boat and not about an individual person. This needs improvement.

Comment about observer health and wellbeing. East coast observers have shorter trips than AK and this has allowed him to be better off mentally. Recuperation is important. Pummeling observers with work is tough. Freelance observers may be better suited to manage their workloads and mental health.
A-observer Said providers sometimes treat observers like a number and when an observer is needed that is the priority and they will be sent out as much as possible for as long as possible. No cell phone service on land in some AK ports and Wi-Fi expensive so limited communication with family and friends. Boats may have Wi-Fi, but may not allow observer access to it.
A-European perspective- thought it was interesting that he thinks freelancing would not be desirable in Europe. In Europe the observers are hired as employees of the institutes and duties are more diverse and EU observers can't make enough as a freelancer.
Comment -Observer also stated he can collect better data if he is not burnt out.

Q- Maybe the UN could help with these international topics. We need a permanent forum for safety.
A-This is critical- management of stocks is reliant on observers and internationally we need to assure safety of those doing this work. Observers are not seafarers so there has been reluctance to address this comprehensibly internationally. No one is willing to address these issues on an international perspective.

Q- Asked for an observer that was not attending- On a national or international level has there been any discussion on a support group for observers or resources compiled for them.
A-The APO had worked on this in the past, but funding and staffing is always an issue.
A-The observer employer is an under-utilized resource for observer support and an opportunity to have providers talk about how to support observers is needed.
A-I had a hard time locating what support is available to observers. Need to make sure observers know what is out there already in addition to improving what support is there. Observer-observer support is paramount. Mental health is not often discussed.
A- European perspective - providers are half/half some government some providers. Training provided by externals, but funding was from institute. European funding are at the European level.

Q- What is the timeline for implementing recommendations of the safety report (OSPR) and what is the plan to communicate the results to observers and programs. Second question- after listening to everyone and hearing concept of safe- we focus lot of time on the easy stuff. Do they have PFD's, EPIRBs, etc… We don't talk about the really hard stuff. Vessel might have EPIRB, but is it in jeopardy of sinking. Vessel condition or even operational things, is the vessel overloaded with pots? Much of this go unaddressed by programs.
A-About the timeline that they just received the final report and the document is now public (April 2018). She is working with the regional offices and the NOPAT(National Observer Program Advisory Team) meetings are being used to track when and how the recommendations are being met. NOAA's new website may be used to provide status reports.
Comment- The EU Union is different- IATTC safety requirements are done by Naval authorities in the associated countries. The risk assessment tool is great and happy that Keith's case was used as an example. Keith's transshipment trip was compliance and not science based. Dolphin safe certification has created safety problems for observers. He

recommends the use of certification or not as a factor in the risk assessment tool. He thinks this raises the risks substantially.
For the large vessels, costs for observer safety equipment are not large. He suggests that NGOs should passionately support the people pushing for observer safety.
A-There is a new report just released by multiple NGOs supporting observer safety. He also agreed that passion is needed to push the issues.

Q- Unfit observers are a risk not only to themselves, but the crew as well. He asked if any programs do drug tests. They do not conduct drug tests in Greenland.
A-The US does use drug tests.

Q-What about harassment and is sexual harassment a serious infringement and should it have serious consequences? He has not experienced it in his programs. He then asked about how we deal with observers refusing trips.
A-EU requires a health assessment to be fit to go to sea (institute).
A-Trip refusals and harassment are addressed in the US and she can talk to him on the side further about it.
Comment- IPHC uses Sharepoint Software to communicate with and amongst observers. Stock assessment authors also provide feedback with regards to questions fishermen have. She would be happy to discuss with others on the side.
Comment- Believes the point about getting provider's together is great and welcomes it.

Poster Presentations – Extended Abstracts

Preparing Observers for Cross Cultural Experiences In Training and In The Field.

Patrick Carroll

NMFS SE Fisheries Observer

Observers work in an often times multicultural environment with many nationalities, customs, and languages at hand. Preparation of observers in awareness to the multicultural nature of the job may go a long way towards helping observers do better work and better their relations with the fisher folk.

Fishing involves many nationalities which the observer may encounter. Even among one's own nationality there may be groups that may be entirely foreign to the observer. It would be interesting to discuss some if not all of these groups during formal training, their customs and cultures could be illuminated, and approaches to dealing with them could be discussed. In the fishery I am currently an observer in, we are often deployed on both Mexican and Vietnamese vessels. My experience with both nationalities has definitely been a cultural experience, particularly in light of my lack of knowledge of both languages, customs and cuisine. My experience on these vessels could have been improved if some sort of initial knowledge about them was provided in training, versus jumping right in. Training could also discuss intra national customs and groups, such as devoutly religious fisher folk as well as ex prisoners. Such training should emphasize awareness of behaviors by the observer that could possibly result in unintentional insult to these groups, resulting in a number of unwanted outcomes. For example, In my experience among particularly religious fishers I have found unintended blasphemy to be highly offensive to them

Perhaps the most significant issue confronting the observer in a multicultural environment is not speaking the same language as the crew they are working with. Not being able to communicate with the crew presents a number of significant challenges to the observer; performance of required data collection duties, effective emergency response, and simple conversation, are all contingent on communication with the crew. Facilitating communication among observers and fishers that do not speak the same language could be achieved in a number of ways. Observers could be provided with tablet computers or apps on their smart phone that translate spoken words as well as text, to be used to communicate with the crews. A simple and cheap option would be the provision of laminated placards in the various languages the observer may encounter. These placards would explain the duties of the observer and their expectations of the crew succinctly so that both parties would know what was expected. The placards could also be designed to contain common nautical and fishing terms as well as species names, in both languages as to provide an easily utilized reference for the observer, pictures of the named objects could also be added for the illiterate. My observer program provides us with such placards , which describe our data collection protocols in Spanish and Vietnamese. I have used them in the field to good effect.

The multinational and multi-cultural nature of the fishing industry presents many challenges to the efficiency and safety of the observer. These challenges can be effectively dealt with through both training and provision of ancillary materials that can be deployed with the observer. The diversity off the various fisheries should be appreciated by the observers sent to monitor them. They offer unique cross cultural experiences which could be reinforced through awareness of them.

I would like to thank the Atlantic States Marine Fisheries Commission for funding my attendance at this conference. I would also like to thank all the great people I have met over the years in the National Marine Fisheries Service Northwest and Southeast regions. Finally, I would like to thank all the fisher folk who have had me on their vessels over the years as an observer.

National Observer Program in Korea, based on Observer-related Keywords from RFMO Regulations using WordCloud

Soojeong LEE, Jeongyun PARK, Jiwoong KO, Taewoo GIM, Seongwoo KOO, and Seonjae HWANG

Korea Fisheries Resources Agency (FIRA)

From 2018, Korea Fisheries Resources Agency (FIRA) is in charge of national observer program. FIRA is quasi-government organization of Ministry of Oceans and Fisheries, Republic of Korea, and Korea's only specialized organization of fisheries resources management, carrying out projects of building marine ranch, marine forests using advanced technologies, operating TAC(Total Allowable Catch) system and observers. Our vision is to lead the efforts to rehabilitate health and abundance in the Korean Waters and management goal to 2030 is as follows. (1) Greenification 75% of the coastal areas, (2) 200% increase in fishermen's income, (3) Highest grade in public evaluation.

We have 36 onboard observers, who collect biological and fishery activity data onboard distant-water fishery vessels. Observers are authorized under domestic legislations, Distant Water Fisheries Development Act and Regulation on Bottom Fisheries in the High Seas, and RFMO CMMs. A total of 31 observers carry out 75 trips, 7846 sea days in 2017. They have been dispatched the convention area of RFMOs such as CCAMLR, WCPFC, IATTC, IOTC, CCSBT, and so on.

After analyzing RFMO regulations using Word Cloud, the keywords related to the observer were shown as fig 1. The most frequently occurring word was 'scientific', followed by 'program', 'WCPFC' and 'assault'.

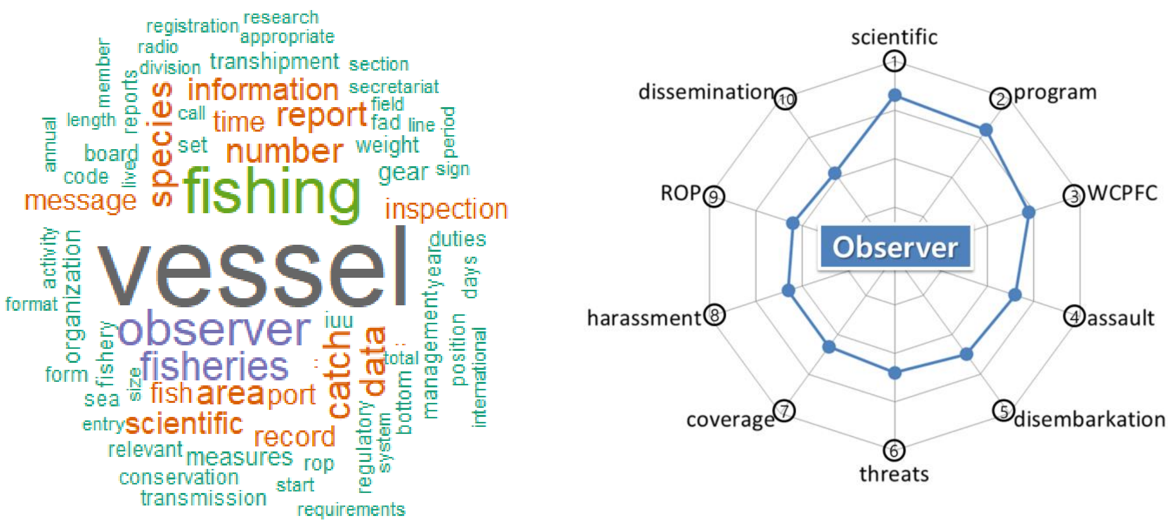

Fig.1. Word Cloud analysis for the RFMOs Observer Regulations(left) and Observer-related Keywords in RFMOs Observer Regulations(right)

First, let's look at our program in terms of 'WCPFC' and 'ROP'. WCPFC secretariat undertook an audit of the Korea Observer Program in July 2017. The secretariat was satisfies that all WCPFC Minimum Standards for the ROP are attained and grants continued "Authorization" to our program to participate in the WCPFC ROP.

Also, in accordance with WCPFC Minimum Standards for the ROP, we are developing the Observer Emergency Action Plan, recognizing that the safety of observers is the most important. We plan to operate a dispute settlement committee. The standard is a dispute resolution mechanism should be in place and a description of the dispute resolution mechanism provided to RFMO.

Secondly, let's look at our program in terms of 'assault', 'threats', and 'harassment'. Most of the crew of Korean distant-water fishing boats are from other countries like Indonesia, Philippine, Vietnam and so on. To help foreign crews understand observer's duties with their smooth cooperation, we made leaflets in five languages, Korean, English, Indonesian, Vietnamese, and Tagalog, and distributed them to all Korean vessels. It contains observer's duty and role, the importance of observers and their data, cooperation of the ship.

Last, to enhance the integrity of observers and to provide against emergencies, we added an anti-corruption class and a survival swimming class to the training course, so observers have to take such classes every year. We also give them various kinds of education like computer skills, photography, and an anti-sexual violence education according to their needs.

Alternate Safety Equipment Examination Protocols

Kara Gibbons, Kenneth Keene

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All United States (US) federally permitted vessels and vessels participating in a Category I or II fleet must have a current United States Coast Guard (USCG) Commercial Fishing Vessel Safety Exam (CFVSE) decal in order to meet US federal observer coverage requirements. Some vessels that participate in commercial nearshore/inshore fisheries in the US Mid-Atlantic are open skiffs less than 26 feet (8 meters) long, on trailers, and launch from ramps scattered throughout the region. Given the remote nature of much of this area, it is difficult and time consuming for the USCG Commercial Fishing Vessel Safety Examiners to inspect these vessels.

Following guidance from the US Code of Federal Regulations 50 CFR 600.746(g), the NOAA NEFSC Fisheries Sampling Branch (FSB) will provide training to pre-approved, experienced observers, observer provider staff, and FSB staff to conduct an Alternate Safety Equipment Examination (ASEE). The ASEE is only applicable to vessels less than 26 feet (8 m) in length, fishing from a remote location in waters less than 3 miles (4.8 km) from shore with no more than 3 people on board. Approval to conduct an ASEE will be given to the observer provider after they provide FSB with adequate proof that a USCG examiner has been contacted and is unable to conduct a CFVSE on a particular vessel.

The ASEE will be completed using the Northeast Fisheries Observer Program (NEFOP) Alternate Safety Equipment Examination Pre-Trip Vessel Safety Checklist (ASEE PTVSC) to ensure the vessel meets all USCG safety requirements. All pertinent fields must be completed and comments on the vessel specifications (e.g., length, area fished) must be included. The observer must have their Personal Locator Beacon (PLB) when they deploy and wear a Personal Floatation Device (PFD) at all times while on deck. In addition to standard observer gear, the observer will carry additional FSB-provided safety equipment, which includes a signal horn, strobe light, and handheld VHF radio.

Web portal for the northeast fisheries observer program

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The Fisheries Sampling Branch's (FSB) Northeast Fisheries Observer Program (NEFOP) observers and monitors collect scientific, management, compliance and other fishery dependent data aboard commercial fishing vessels covering ports from Maine to North Carolina. Required reporting of incidents and enforcement boardings, observer certifications and contact information, observer deployments from scheduled to landed and various other internal and external information, created a critical need for a web based management system. On 1 November 2016, the FSB Web Portal was deployed for observers and monitors, observer service providers, FSB staff, United States Coast Guard (USCG) and National Marine Fisheries Service's (NMFS) Office of Law Enforcement (OLE).

The observer and monitor dashboard provides a mechanism to submit an incident or enforcement boarding report. Incidents such as situations related to safety-issues, conflicts with industry, injuries, and other items an observer reports to the FSB are submitted through the Portal and available immediately to FSB and OLE staff. The Portal also provides a quick and efficient follow-up procedure by FSB staff and allows the observer to view the person their incident was assigned to and the status of the follow-up. The Portal provides access to NEFOP manuals, newsletters, memos and reference guides. The Portal also provides the ability to view captain interviews completed after deployment and any fisherman comment cards mailed to the FSB. Observers and monitors can view the expiration dates of their gear certifications and safety training. Observers and monitors are also able to track their deployments, days at sea and fishery certifications.

The FSB has established a Species Verification Program (SVP) to document and evaluate the accuracy of observers' identification of encountered species and to provide quick response and resources to maximize the quality of observer data. The SVP requires the submission via photos and/or specimens of all marine mammals, turtles, birds, sharks and many fishes and squids that have high ecosystem or commercial importance. SVP data is used to provide prompt feedback to observers and FSB staff about species verification issues, to modify trip data consistent with observer verification abilities, to improve training methods, and to help end users evaluate the accuracy of the catch data. Reliable and fast information on species verification is critical to providing quality data. The Portal provides observers with their SVP compliance status for current and past quarters as well as direct feedback from FSB SVP staff on their submitted samples and photographs. Observers are able to view positive identification and any comments on species that were identified incorrectly for the last 6 months immediately after review.

The observer service provider dashboard displays an overview of various information related to the observers and monitors they employ. Information includes career statistics, gear and safety training certifications, monthly sea day average, distribution of trips, SVP compliance, data quality reviews, fishery certification, emergency contact information and trip deployment data. Trip deployment data from the Northeast Fisheries Science Center's

Pre-Trip Notification System for the Northeast Multispecies groundfish fishery and from the Atlantic Sea Scallop notification system are displayed on the Portal for observer service providers to schedule observers and monitors. Dock intercept trips are also entered by the providers. The observer service providers schedule trip deployments and move them through states of being scheduled, at-sea and completed. This trip management system maximizes vessel coverage and seaday accomplishments. They also submit captain interviews that they conducted after an observed trip deployment through the Portal. Providers are required to maintain personal locator beacon identification with battery and registration expiration dates for each observer and monitor. If a vessel's life raft capacity is not sufficient to take an observer on a trip, the provider can borrow a NMFS owned life raft for the observer to take on the trip. The Portal provides a tracker for the NMFS owned life rafts displaying which life rafts are available or already signed out by another provider. This allows the providers to communicate with each other if a life raft is needed after one that is signed out has returned from deployment to ensure that observers are using all available life rafts.

The FSB staff dashboard is managed with different accessibility roles to provide the appropriate level of security to the various modules available on the Portal. Staff can view all of the information available on the observer and observer service provider dashboard along with additional data and statistics. Observer trip deployments are easily accessible from the FSB staff Dashboard. FSB staff can view trips that are scheduled to sail, those that are at sea and those that have landed. Trips that were scheduled to sail but end up not being covered by an observer or monitor are also available for view. This provides FSB staff with instant access to which observers or monitors are at sea and which vessels they are deployed on which has been invaluable during at-sea emergencies. Individual trip information can be viewed at a glance and accessed by clicking on an observer’s trip identifier. This includes vessel information, sailing and landing dates and ports, seaday reference or fishery confirmation numbers, trip deployment status and a photograph of the observer. FSB staff also have access to exit interviews completed by observers and monitors leaving the program and a complete follow-up procedure on any incident reports submitted by observers or monitors.

The Portal provides USCG and NMFS OLE with observer at-sea deployments including the vessel name, trip dates, vessel sailing port, and observer identification if an enforcement boarding or emergency occurs. Observer reports on enforcement boarding and incidents that may occur during their deployment are also provided. A listing of vessels with ongoing concerns is readily available.

The FSB Web Portal is constantly evolving, regularly providing enhancements and adding new modules to support the work of the FSB, observers and monitors, observer service providers, USCG and NMFS OLE.

A Life of Monitoring the Fisheries: Quantification of the Individual Sampling Effort of a North Pacific Groundfish Observer.

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An observer's job working in the North Pacific Observer Program is unique, challenging, and constantly evolving. Observers work for extensive periods of time on imperfect sampling platforms exposed to extreme weather conditions, rough seas and potentially hazardous work environments. Observers on commercial fishing vessels are faced with complex sampling situations constrained by vessel operations and environmental conditions. To be successful, observers must be flexible, able to solve problems and make sampling decisions without supervision. Professional attitude, self-motivation, and integrity are fundamental qualities that observers must have to overcome complicated and demanding work scenarios.

To collect the high-quality data needed to meet fisheries management goals, observers are trained to maximize the sampling fractions and number of samples, relying on randomization and unbiased sample designs. The samples fractions that an observer can achieve are dependent on the sampling environment and the available tools (Cahalan, 2010).

The sampling tools available to the observers are generally limited to four sampling baskets, spring scales, knife, and length measuring strips, waterproof deck sheets, and tally counters. On the other hand, to collect biological samples the observer is also provided with otoliths vials, salmon scale envelopes, assorted plastic bags, waterproof tags, scalpels, marine mammal sample kit and a digital camera. Additionally, observers deployed aboard catcher processors also have access to motion compensated electronic scales (MCP), flow scales, and sampling stations.

The sampling, paperwork, data entry and error checking involved requires observers to work long and odd hours, seven days a week, and results in intense and grueling schedules. The physical demands of sampling combined with erratic opportunities to sleep or eat can take a toll on the individual, causing work health related issues (especially back pain) even several weeks after finishing a deployment. In a typical sampling collection day, observer deployed in catcher processor longline sleep no more than 6 hours and spend around 9 hours on open boat deck exposed to temperatures below zero. In a factory trawler, two observers are working for 12 hours on an almost continuous cycle of sampling collection. In this kind of fisheries, the processing of the samples consumes about the 80% of the working hours stopping just during meals times. Usually, the paperwork and data entry have to be completed after their shift is over.

Nevertheless, throughout each deployment, observers collect on a daily basis, fishery-dependent information on a broad range of fisheries management related goals, reporting through the year several thousands of fisheries records and collect hundreds of biological samples. Data collections include, but are not limited to, sampling for species composition, length and age distribution, reproductive and maturity data, genetic and biological specimens, in addition to supplemental agency directed research projects. This effort varies with the different vessel types (catcher only versus catcher-processor vessels) and gear types (hook and line, pot and trawl). (Tables 1 and 2).

TABLE 1. Summary of the total hauls and samples collected daily by individual observers by data collection day and vessel gear type. North pacific (NORPAC) Groundfish and Halibut Observer Data 2017 (January - December). **CV** = Catcher Vessel, **CP/M** = Catcher processor and Motherships, * = Not applicable.

FISHERIES GEAR	NUMBER OF HAULS SAMPLED DAILY (avg)		SAMPLES COLLECTED DAILY (avg)							
			NUMBER SAMPLES		KG		HOOKS		POTS	
	CV	CP/M	CV	CP/M	CV	CP/M	CV	CP/M	CV	CP/M
PELAGIC TRAWL	1.85	2.60	4.14	6.55	471	60,978	*	*	*	*
NON-PELAGIC TRAWL	1.97	2.56	3.68	7.04	564	717	*	*	*	*
LONGLINE	2.50	1.33	7.00	3.90	*	*	1,568	9,388	*	*
POT	1.82	2.60	5.19	8.16	*	*	*	*	33	38.01

TABLE 2. Summary of lengths, otoliths and halibut viabilities collected daily by individual observers by data collection day and vessel gear type. North pacific (NORPAC) Groundfish and Halibut Observer Data 2017 (January - December). **CV** = Catcher Vessel, **CP/M** = Catcher processor, and Motherships.

FISHERIES GEAR	LENGTHS		OTOLITHS		HALIBUT VIABILITIES	
	CV	CP/M	CV	CP/M	CV	CP/M
PELAGIC TRAWL	26.5	44.1	4.3	4.6	0.0	0.4
NON-PELAGIC TRAWL	37.3	45.6	5.4	4.2	4.3	8.6
LONGLINE	29.8	37.3	4.4	3.1	3.0	1.3
POT	29.7	62.4	3.9	3.9	1.3	0.8

The combined individual sampling effort of the 383 observers deployed on 748 different cruises (assignments) during 2017, produced a vast quantity of biological records gathered during the course of more than 27,000 data collection days including full coverage and partial coverage observers. More than 51,000 hauls were sampled, 158,000 samples were taken and more than 322,000 MT of samples were weighed using observer balances, motion compensated scales (MCP) and flow scales. On the other hand, 261 species were individually counted in the species composition samples, totalizing almost 45 million organisms. Furthermore, 1.1 million lengths, around 57,000 otolith pairs, 21,000 salmon specimens and nearly 104,000 halibut viabilities were collected.

This information provides the best available scientific information to manage and monitor Alaska's fisheries. The data allows managers to predict environmental impacts that are affected by fishing activities and to develop measures to minimize bycatch. While observer sampling effort is usually defined by sample fractions and number of samples, the effort required by the observer to collect these data is often overlooked. Nevertheless, the data clearly reflects that despite all the physical limitations of space and time, and in extremely harsh environmental conditions fisheries observers working in the Alaska fisheries still are fully capable of collecting consistent and reliable biological data. Fisheries observers can perform efficiently under any working conditions applying training, knowledge and a remarkable work ethic to overcome complicated sampling scenarios.

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Regional Scientific Observer Programme (RSOP) of the South West Indian Ocean

Jérômine Fanjanirina, Daroomalingum Mauree

Indian Ocean Commission

Background

The global tuna industry is multi-billion-dollar business, the Indian Ocean having the second largest world tuna fisheries after the Western Central Pacific Ocean. It accounts for approximately 1.2 million tonnes of tuna caught per year and consists of four main tuna species namely, Yellowfin, Skipjack, Albacore and Bigeye. The SWIO share of global tuna caught is about 450,000 tonnes and the breakdown is as follows: Industrial tuna fisheries (Purse seine: 300,000 tonnes and Longline: 115,000 tonnes and small-scale chilled tuna fisheries: 35,000 tonnes).

Economic potentials of the SWIO tuna fisheries

The landed value tuna harvested in the SWIO basin is estimated at US$ 1 billion and about US$ 3 billion at end market price. The overall economic benefits derived by the ESA-IO countries is roughly estimated at US$ 500 million, approximately 20% of its potential. Around 55% of the total catch is taken in the Exclusive Economic Zones (EEZ) of neighbouring coastal states and the remaining, from the high seas (also known as Areas Beyond National Jurisdiction or ABNJ). The purse seiners or the canned tuna value chains constitute the big chunk of the regional tuna industry and are intimately linked to preferential access to the European markets.

The total financial compensation received by SWIO countries for access of the EU fleet is approximately € 20 million per year, which is almost 10% of total landed value of the catch harvested in the EEZ of the coastal states. About 80 % of the tuna caught by the purse-seine fleets are processed into canned products and loins in the region, mainly in Seychelles, Mauritius and Madagascar.

South Korean, Mauritian and Seychellois-flagged purse seiner fleets also access the SWIO coastal states waters through bilateral fishing agreements.

The South East Asian Tuna Longliners (TLL) fleets access the SWIO coastal states waters under private licenses or agreements. The largest tuna base of the South-East Asian TLL fleets is in Mauritius, where approximately 65,000 tonnes or nearly 60% of total catch in the Indian Ocean is discharged and/or transhipped annually.

<u>The RSOP</u>

The Regional Scientific Observer Programme (RSOP) overseas an area of nearly 10,000 Km^2 and embraces the EEZ of the twelve countries of the South West Indian Ocean (SWIO).

Creation of a Working Group (WG) for the National Observer Programme (NOP) Manager of Southwest Indian Ocean to implement the Sub-regional Observer Scheme at the level of the SWIO region, in order to coordinate the deployment of observers and to improve the catch and effort data and other relevant information in line with the conservation and management measures of the RFMOs and Agreement.

The WG works under the aegis of the RSOP piloted by the Regional Fisheries Surveillance Plan (PRSP) mechanism and the World Bank SWIOFish 1 project of Indian Ocean Commission (IOC).

The development of RSOP is in line with the United Nations Convention on the Law of the Sea of 10 December 1982, contributing to the conservation and management of marine living resources.

The legal status of the management and conservation of marine living recourses, the most important of these were:

• The 1993 Compliance Agreement;

• The 1995 The FAO Code of Conduct for Responsible Fisheries;

• The 1995 United Nations Fish Stocks Agreement.

The South West Indian Ocean Fisheries Commission (SWIOFC), the Indian Ocean Tuna Commission (IOTC) and the IOC and work closely on large pelagic fisheries and support countries to meet their Regional Fisheries Body (RFB) obligations. The Commissions acknowledge the importance of the best scientific evidence available to support the conservation and management decisions for fisheries and recognize the value of monitoring and verification of fishing operations. Consequently, they recognized the importance of high quality standards through the adoption of guidelines to collect and report relevant fisheries data.

The obligation of the Indian Ocean Tuna Commission (IOTC) country member States to deploy observers on-board their small scale and industrial national fleets has created the need for the NOP to coordinate observer deployments in order to meet their national and international obligations, and respect private agreements established with the industry.

The RSOP is an ideal tool to help SWIO States to fulfill their obligations and implements RMFO resolutions, namely IOTC resolution 11/04 on Regional Observer Scheme and to raise the level of compliance to the other resolutions on the recording of catch and effort data.

The RSOP plays a valuable role in validating catch and effort data collected through logbooks, but they also provide more detailed scientific information that is not taken from logbooks. This information contributes towards the assessment of stocks for management and conservation. Observers follow a strict sampling protocol to monitor tuna purseiners and longliners fishing in IOTC regions.

The exchange of data collected by observers through regional data base "StaRFISH"; the certification of the observers (standardization of training programme and data collection; stringent health and safety standards applicable to operational aspects, and others); the coordination of observer deployment at regional level; the accreditation of the regional observer, etc. are of the rules of the WG.

Since the implementation of the RSOP in 2015 , the number of observer deployments and the number of days at sea have increased. In 2017, 42 Scientific Observers were engaged on board of fishing vessels in the IOC waters and East African Waters through 236 deployments and undertook 6537 days of observation at sea.

Enhancing documentation systems and training to encourage the reporting of problems all observers may face

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There are a wide range of challenges and problems that observers may face from the moment they set up a trip on a vessel throughout their deployment. The Fisheries Sampling Branch (FSB) in the Northeast United States encourages observers to report all problems that occur while performing any observer duties, no matter how minor, in the form of an Incident Report. Incidents include but not limited to vessel/observer safety concerns, failures to comply with laws and regulations, injuries, and/or issues with vessel selection. FSB staff recognized observers were not reporting all incidents and developed tools that have simplified the reporting process and training to help alleviate some of the concerns/issues observers have that cause them not to report.

Prior to November of 2016, to submit an Incident Report, observers were required to complete a fill-able PDF with digital signature and submit via e-mail to multiple FSB staff members. This system of submitting an Incident Report was cumbersome; often requiring observers to call staff for support due to technical difficulties, and program follow-up could be delayed by missed emails or communication breakdowns. To provide observers with a user-friendly reporting system with a quicker and more efficient follow-up procedure by FSB staff, the FSB developed and implemented a web portal on November 1, 2016. The interface is very simple to use; observers simply log into the portal and select a link to enter a new Incident Report. They then fill out vessel and trip information, if relevant, using fill-in-the-blanks, auto fill and drop down menu options. To submit the report they simply click a button and then the report is immediately available for FSB staff to view for follow-up.

Once reports are submitted to the observer program, select staff review the reports and assign a status code. The observer has the option to view all Incident Reports they submitted to the program, the assignee, and what is happening with their report at any time by logging into the web portal. The benefit to this is the observer immediately knows who to contact at the observer program with questions, for additional incident details, or support. The portal has proven to be an effective method for program staff to understand challenges observers face and be able to better support observers while they are in the field. FSB saw a significant increase in reporting since the implementation of the web portal, including a 138% increase of total reports submitted between 2016 and 2017.

While the new system is more convenient for reporting and tracking, observers still exhibit reservations with reporting incidents. There are many reasons observers may not want to report a problem. Through in-person debriefings and surveys, FSB recognized that many of these concerns were related to not thinking the event was serious enough, thinking nothing would be done about it, not knowing what they should be reporting, or having difficulty with the reporting system.

New methods of training were developed to focus on removing these reservations and encourage observers to report problems contemporaneously. One of the fundamental goals of training is to promote a safety culture that not only benefits observers but their counterparts in the field. Safety Culture “is the concept that forms the environment within which individual safety attitudes develop and persist and safety behaviors are promoted.” (Mearns, 2003). Observer safety culture is comprised of situational awareness, proper training, and a responsive support system which empowers the observers to mitigate issues and perpetuate appropriate boundaries. (Cowan, 2015). To promote this culture, FSB has adapted several training strategies including realistic role play scenarios, an observer support panel discussion, and repetitive need recognition throughout training. The role plays focus on helping observers recognize situations that are significantly underreported due to difficulty with recognition, such as harassment (as identified in a recent FSB observer survey). Observers participate in an open discussion with representatives from the NOAA Office of Law Enforcement, the US Coast Guard and the FSB observer safety team during initial training which illustrates the support observers will receive when issues arise. This helps with increasing understanding on how Incident Reports will be handled once submitted and alleviates the feeling that nothing will be done to follow-up. Lastly, throughout training, staff consistently highlight situations and events where reporting will enhance the observer experience by increasing overall safety and the ability to do their job effectively. This assists observers with recognizing when they are in a situation that may warrant reporting.

Incident Reporting is an important component of a good observer support system. Under-reported incidents could potentially have dire consequences; therefore, it is critical to have a user-friendly reporting system in place that allows for timely communication between observers and program staff about any of these issues as well as in-depth training on what and how to report.

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Frequency of safety and harassment violations types and the factors that impede disclosure

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Abstract:

National Marine Fisheries Service (NMFS) certified observers are a vital part of fisheries management. Observers are deployed to collect fisheries data in the field; observers often deploy to vessels and work alongside fishers for weeks and months at a time. The work environment observers find themselves in can be challenging, especially if observers find themselves a target for victim type violations such as sexual harassment, intimidation, or even assault. NMFS Office of Law Enforcement prioritizes investigations into allegations of sexual harassment, hostile work environment, assault and other complaints, which may affect observers individually.

The Office of Law Enforcement, Alaska Division, conducted an anonymous electronic survey of North Pacific Observers to determine the number of observers who experienced victimizing behavior during deployments in 2016 and 2017. The survey also investigated the

reasons that prevented observers from reporting these violations. From these survey results, the Office of Law Enforcement has a better understanding of how often observers are victimized, enabling them to reallocate resources as needed, conduct more training for observers to ensure they know how to report, conduct training to ensure people understand what constitutes a victim crime, and to increase awareness of potential victimizations. Additionally, the survey results will help law enforcement understand the barriers to disclosure, so enforcement may begin to address these impediments so they no longer prevent observers from disclosure.

Introduction

National Marine Fisheries Service (NMFS) certified observers are a vital part of fisheries management. Observers are deployed to collect fisheries data in the field; observers often deploy to vessels and work alongside fishers for weeks and months at a time. The work environment observers find themselves in can be challenging, especially if observers find themselves a target for victim type violations such as sexual harassment, intimidation, or even assault. NMFS Office of Law Enforcement (OLE) prioritizes investigations into allegations of sexual harassment, hostile work environment, assault and other complaints, which may affect observers individually. However, it is difficult for a person to disclose if they have been a victim of a crime, and law enforcement cannot respond if no complaint is submitted. The true number of observers who have experienced victim type crimes is unknown, and the reasons why they do not report is also unclear. More information is needed to understand how many observers per year experience victim type crimes, and why they chose not to report to law enforcement.

An anonymous survey was created by Jaclyn Smith, a Special Agent with NMFS OLE in the Alaska Division conducted a survey of North Pacific Observers to determine the number of observers who experienced victimizing behavior during deployments in 2016 and 2017. The survey also investigated the reasons that prevented observers from reporting these violations. The survey is currently still open, and data continues to be collected.

The results of the survey will provide OLE a better understanding of how often observers are victimized, which will enable them to reallocate resources as needed, conduct more training for observers to ensure they know how to report, conduct training to ensure people understand what constitutes a victim crime, and to increase awareness of potential victimizations. Additionally, the survey results will help law enforcement understand the barriers to disclosure, so enforcement may begin to address these impediments so they no longer prevent observers from disclosure.

Material and methods

A web based survey was used, with the link being emailed to all North Pacific Observers who deployed in 2016 and/or 2017. The first section of the survey is an introduction, with no questions asked. The second section of the survey will determine basic demographics of the respondent. This is to determine if there is any correlation associated with demographics. The third and fourth sections of the survey asks questions regarding the respondent’s safety and security on deployment, followed by questions seeking to understand any impediments to disclosure. The third and fourth sections have the same exact questions; the second part is for 2016 deployments and the third part is for 2017. The fifth and sixth sections of the survey thank the respondent for their time; the fifth section is meant for anyone who did not deploy in the North Pacific Observer Program in 2016 and 2017, while the sixth section is for respondents who complete the survey.

Preliminary results and discussion

Preliminary results between 2016 and 2017 suggests there is a decrease in safety and harassment type violations observers experienced. This may be due to the change in training, increased outreach, and enforcement efforts. At the end of 2016, the Office of Law Enforcement began meeting with individual fishing companies to discuss the types and frequencies of violations occurring in the fishing fleet overall, and on the company's individual vessels. Additionally, the Office of Law Enforcement conducted an operation in early 2017, focusing on observer related violations, in Dutch Harbor, AK, the busiest port in the United States.

The results here represent the percent of observers who responded that they did experience a certain type of safety or harassment issue. Observers were required to respond to each question. In 2016, 21 female observers and 31 male observers responded. In 2017, 21 female observers and 26 male observers responded.

Table 1. Safety and Harassment Violation Types Experienced by Observer While on Contract in 2016 and 2017; Females compared to Males

Safety and Harassment Violation Types Experienced by Observer While on Contract	2016		2017	
	Female	Male	Female	Male
Made to fear physical injury	19%	7%	14%	8%
Threatened with physical injury	0%	3%	0%	4%
Intentionally physically injured	0%	3%	0%	0%
Physically prevented from performing duties	14%	3%	10%	4%
Threatened to prevent performing duties	10%	0%	0%	0%
Forced to, or an attempt to make observer, change data	19%	6%	10%	4%
Bribed to change data	0%	0%	5%	4%
Received offensive comments made regarding age, sex, sexual orientation, religion, or race/ethnicity	43%	10%	38%	4%
Received unwelcome or unwanted comments of a sexual nature	52%	6%	43%	0%
Attempts to touch in an unwelcome or unwanted sexual manner	24%	0%	10%	0%
Touching in an unwelcome or unwanted sexual manner	10%	0%	5%	0%
Forced to participate in any sexual activity against observer's will, or without consent	5%	0%	0%	0%
Interference with or biasing sampling procedure	29%	10%	10%	19%
Tamper with, destruction of, or discard of samples, equipment, records, photographic film, papers, or personal items	5%	3%	14%	12%
Refusal of reasonable assistance which impacted data or data collection	10%	23%	10%	19%
Treatment or work environment caused observer to change own behavior or work schedule	62%	19%	24%	19%
Required or pressured to perform any duties normally performed by crew members	5%	16%	5%	4%
Failure to have a look out/wheel watch	14%	13%	10%	8%
Drugs or alcohol use by person(s) operating the vessel, equipment or machinery	5%	23%	10%	8%
Unsafe conditions onboard the vessel/at the processor	14%	32%	19%	15%

Table 2. Factors Impeding Observers from Disclosing Experiences to NMFS, OLE, or their Employer in 2016 and 2017.

Factors Impeding Disclosure	2016	2017
Feared Retailiation	5	2
Minimization	14	11
Feared loss of privacy	1	2
Thought it was too late to report	2	2
Didn't recall all details	1	1
Self blame	3	1
Distrust of NMFS, law enforcement or observer provider	4	1
Belief that nothing will be done about complaint	8	7
Fear of losing job	1	2
Didn't want to get anyone in trouble	8	3
Didn't want to participate in justice process	4	0

Conclusion

The Office of Law Enforcement will continue to prioritize the safety and security of observers. Enforcement action should be taken when possible, however, for enforcement action to be taken, observers must be willing to report their experiences. Current training given by the Office of Law Enforcement seeks to build rapport and trust with observers. This type of training will continue, and more interaction between observers and law enforcement will be encouraged. Additionally, the Office of Law Enforcement will continue to work directly with individual fishing companies to address any and all complaints seen in the fleet and on individual vessels. Responsibility for observer safety and security needs to be shared between law enforcement, NMFS, observer contractors, vessel companies and anyone who may have the opportunity to ensure the working environment for observers is safe.

Acknowledgement

Thank you to Julie Dale McNeese with Standing Together Against Rape (STAR). Her dedication in educating the public is inspirational. Thank you to Enforcement Officer Amy Rollins. Her commitment to observer safety and her determination to thoroughly investigate observer crimes is admirable and inspirational.

Argentina. Training of new observers during 2016

Lic. Gabriel Blanco

National Institute of Fisheries Research and Development, Argentina

Introduction

In a context of growing need for information on resources subject to sustained fishing pressure, the INIDEP Observer Program has a very significant contribution. The presence of well trained and equipped technical personnel on board a fishing vessel is a way to improve the quality of the information generated by the fishing fleet. The result of the data comes from the direct observation of the technician on board, who uses objective methods to avoid biases attributable to the application of subjective criteria. It also eliminates the dependency on the declaration of an interested party, which allows knowing the details of the activity that would otherwise not be accessible.

The demand for this training arises from the lack of Scientific Observers in 2016 to meet the requirements of INIDEP's research programs, in different fleet strata.

Recipients

The profile of the recipients depends mainly on the work to be carried out on board the fishing vessels. Therefore, it is desirable that they meet a series of minimum and desirable exclusionary requirements to be admitted as candidates for the course.

Applicants selection

Two criteria will be used. The first will consist of a qualification made based on the background, previous training, experience in navigation and a test of performance in calculation and capacity in technology management (PC)

ITEM		SCORE
Tertiary / University Studies		
	In relation to Biological Sciences	20
	Not related to Biological Sciences	10
	Without studies	0
Navigation experience		
	Maximun	30
	Average	20

	Relative	10
	Without experience	0
Availability of boarding		
	With availability	10
	Relative availability	5
	Without availability	0
Performance test in Calculus		20
Capacity test in technology management (PC)		20

The second criterion will be in charge of qualified professionals on personnel selection, who will evaluate the occupational characteristics of future observers according to the following competencies:

- Cognitive skills
- Attitudinal skills
- Social skills

Qualitative scale (Human Resources Management Criteria)	Quantitative scale (Score obtained in interview by competitions)
Very suitable	100 – 90
Adequate	80 – 60
Not suitable	50 – 40

Objectives

Train scientific observers on board commercial fishing vessels in:

- Obtain basic biological-fishing information.
- Identify fishing gear used, its selectivity, performance and efficiency.
- Recognize characteristics of fishing vessels and on-board processing technologies aimed at verifying and updating the existing information on fleets and to update conversion factors applied to each product.
- Recognize fish species, birds, mammals and marine reptiles, by means of the taxonomic determination to the greatest possible degree.
- Report activities according to current regulations.

<u>Contents</u>

The contents are organized into modules that integrate conceptual and practical aspects in the following sequence:

- MODULE I Observers program
- MODULE II Navigation and Safety in Navigation
- MODULE III Fishing Gear
- MODULE IV Survey of biological fishery information
- MODULE V Ecosystems at Argentine Sea
- MODULE VI Hake Fisheries and Accompanying Fauna
- MODULE VII Cephalopod Fishery
- MODULE VIII Shrimp Fishery
- MODULE IX Scallop Fishery
- MODULE X Southern Species Fishery
- MODULE XI Coastal Species Fishery
- MODULE XII Crab and Centollón Fishery
- MODULE XIII Anchovy and Mackerel Fishery
- MODULE XIV Chondrichthyes Fishery
- MODULE XV Marine Birds, Mammals and Reptiles
- MODULE XVI Benthic invertebrates
- MODULE XVII Fisheries Certification. Eco labels

The following Topics are included as magnetic reading material:

- Fisheries Economy.
- Fishing Products Processing Technology.
- Fisheries assessment models.
- CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources).

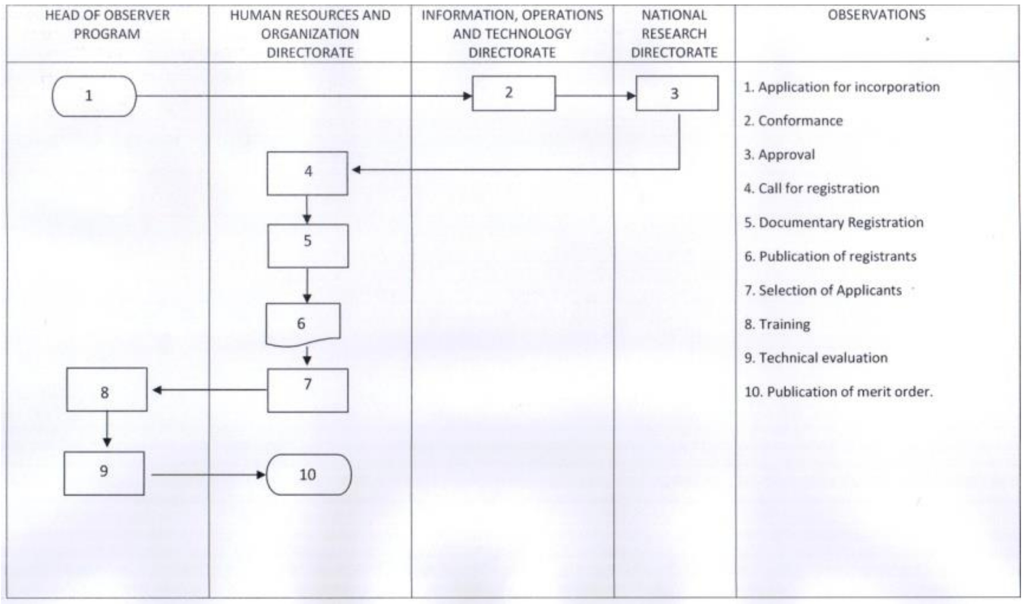
<u>Modality</u>

The training is developed in face-to-face mode - workshop at the INIDEP facilities and the National Fishing School, from Monday to Friday from 9 a.m. to 12 a.m. and from 1 to 4 a.m.

Approval conditions

- 80% attendance at face-to-face meetings
- Approval of the integrating work of each module
- Approval of partial evaluations
- Final evaluation approval.

Flow chart to incorporate new observers



THE TRAINING LASTS FOR 220 TOTAL HOURS, DISTRIBUTED IN 124 THEORETICAL HOURS AND 96 PRACTICAL HOURS.

FINALLY, AFTER RECEIVING MORE THAN A HUNDRED APPLICANTS, 30 WERE SELECTED, 28 SUCCESSFULLY PASSED THE COURSE AND TODAY THEY ARE WORKING FOR THE INIDEP OBSERVER PROGRAM, 22 NEW OBSERVERS.

Once the course is finished, the training of new and experienced observers continues throughout their career, attending continuous training workshops, exchange of experiences and constant interaction with INIDEP's Research Programs.

Currently, the INIDEP Observer Program is training new observers for the Provinces of Chubut, Santa Cruz and Tierra del Fuego

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Observer Incident Response Protocols for the West Coast Groundfish Observer Program

Scott Leach

West Coast Groundfish Observer Program

Commercial fishing is a dangerous profession and the West Coast Groundfish fisheries are no exception. Despite best efforts by the fleet and West Coast Groundfish Observer Program (WCGOP) staff and observers, observer-involved safety incidents do occur. When these incidents happen response protocols ensure that matters are handled efficiently and effectively with a focus on observer safety, mutually beneficial outcomes, and prevention of future occurrences or escalation. The WCGOP has developed a response protocol system that categorizes safety incidents as “Low”, “Moderate”, or “High” priority. These categorizations and the resulting response trajectories are presented to WCGOP observers during training sessions for new observers, as well as, briefings for returning observers. A review of WCGOP observer-involved incidents from 2011 through 2017 found that observers frequently underreported low and moderate priority issues. Our goal in instructing observers in incident prioritization and response protocols is to prevent underreporting, which can lead to low to moderate issues that escalate to high priority problems.

Low priority issues are defined as those that do not immediately put the observer in a life-threatening situation, may or may not affect the observer’s ability to sample effectively, and may or may not require action from the National Oceanographic and Atmospheric Administration (NOAA) Office of Law Enforcement (OLE). Examples of low priority incidents include; Marine Pollution (MARPOL) violations, parted wires, loss of engine or electrical power, loss of vessel control system, or minor observer illness. The WCGOP requires that observers thoroughly document this type of incident in their logbook Daily Notes section and Vessel Safety Survey. Logbooks are submitted to WCGOP debriefers on a monthly basis. Any documented incidents are entered into the Logistics and Observer Tracking database (OBSLOG) along with scanned copies of Daily Notes and Safety Survey. NOAA OLE, United States Coast Guard (USCG), and Observer Coordinators have access to the OBSLOG and may review and respond to recorded incidents as required. This flow of information usually takes one to two months with incident response occurring after responding parties receive the Daily Notes and Safety Survey for review.

Moderate priority issues are highly variable in nature and may affect the observer’s ability to sample and/or the safety of the observer or other vessel personnel. Examples of incidents that would be classified as moderate priority include sampling interference, incidents involving significant harm to the environment, observer safety, observer harassment or intimidation, observer illness or minor injury, or person overboard. Just as with a low priority incident, the observer thoroughly documents the details of the event in their logbook Daily Notes and Safety Survey. However, in incidents of moderate severity, the observer is also required to contact their Observer Coordinator. The Coordinator then requests copies of the Daily Notes and/or Safety Survey and begins communication with NOAA OLE and/or USCG. This allows for a faster response time anywhere from a few days to weeks after the incident occurs.

Incidents classified as high priority put the observer in immediate danger and thus illicit an immediate response, with action taken within 30 minutes of event notification. Examples include assault, sexual harassment, vessel collision, vessel fire, or vessel flooding. In these cases, the observer activates their Personal Locator Beacon (PLB) and, if possible, contacts their Observer Coordinator using a personal cell phone or vessel satellite phone. The

Observer Coordinator begins immediate communication with NOAA OLE and USCG and emergency response plans are activated.

WCGOP observers learn to identify incidents as low, moderate, or high priority during trainings and response protocols are reiterated during yearly briefings. The effect of this is two-fold; (1) low and moderate priority issues are reported to NOAA OLE and USCG in an organized and timely manner helping facilitate effective response and (2) more low and moderate level issues are reported overall, which helps identify vessels that may be at higher risk for severe events. Identifying risk helps the WCGOP improve the safety of its observers and the fleet.

Special thanks to the Special Agents and Officers of NOAA Office of Law Enforcement. Their quick response, relationship with the fleet, and knowledge of the WCGOP allows observers to collect the data that is used for fisheries management.

Additional gratitude and recognition go to the WCGOP observers for their hard work and effort in collecting West Coast fisheries data.

Abstracts of presentations that did not provide Extended Abstracts

NOAA Fisheries Observer Safety Program Review

Elizabeth Chilton, Dennis Hansford

NOAA, National Marine Fisheries Service, National Observer Program

The health and safety of U.S. and international fishery observers is a top priority for NOAA Fisheries. In 2016, NOAA Fisheries launched a comprehensive review of fishery

observer safety and health to gather and assess information from key partners and recommend improvements. Four independent experts with extensive observer or safety experience conducted regional site visits, including the national program, and attended safety trainings occurring at all regional observer programs. The independent reviewers also engaged in feedback sessions with observer provider companies and observers focusing on their safety and health interests. The review documented areas for improvement in seven key safety and health components: 1) safety reporting; 2) communications; 3) practices and policies; 4) training; 5) regulations; 6) equipment; and 7) international issues.

The final report, documenting areas of improvement at the national, regional and international level, was submitted in January of 2018. NOAA Fisheries will work with our national and regional observer programs, as well as observer provider companies, to implement safety and health recommendations such as improving regional emergency action plans and updating national policies on observer safety training and minimum eligibility requirements.

Recommendations for observers deployed in international fisheries will be forwarded to regional fishery management organizations in collaboration with the International Affairs Division of NOAA Fisheries.

Complacency Kills- Experience doesn't Trump Safety

Paul Martin, Samantha Power

Teamsters Union/ Seawatch

Our poster presentation will focus around Observer and Owners Complacency and Bad practises on board Vessels; pre-trip safety check-list; Safe Boat Access (Gangways) and 24 hour Watch.

Bridging the Gap Between Observer Harassment and Response

Marc Dragiewicz

NEFOP/MRAG observer

I have been a fishery observer for twenty-one years in five different programs on both coasts of the US and Alaska. Despite the difficulties of such a diverse work environment, I appreciate the positives, including memorable experiences at sea as well as the flexible schedule.

Professional fishermen operate in a challenging environment – regularly enduring long hours, intense physical labor, and exposure to the elements at sea. Nevertheless, fishermen usually treat observers fairly, if not like one of the crew. This can make the difficult work of a fishery observer more favorable.

That being said, one confrontational crewmember can make work problematic; and a confrontational crew can make work impossible. Looking back, my biggest regrets are the times when I did nothing, or very little, as I was harassed, treated inappropriately, or subjected to unsafe conditions. I want to promote a healthier work environment for my observer colleagues, and I realize that I was failing them when I was not proactive in my response to, or reporting of, harassment situations.

I believe the most significant gap in the process of addressing harassment is the failure by observers to report incidences in the first place, which does nothing to improve conditions for the next observer. Based on my own experiences and discussions with others, there are various reasons for this.

My analysis, through collaboration with the observer community, will describe the rationale behind observer reluctance to report harassment-type incidents and outline different methods of addressing these reservations. This assessment, presented to new and experienced observers, can encourage greater responsibility for reporting of harassment, which will promote a more productive and secure work environment.

Technologies in Marine Fisheries: #SAFETY

Ken Keene

NOAA/NMFS/NEFSC

Technology is flourishing and has become a substantial part of our everyday life. From being able to check your emails anytime/anywhere to making video calls to loved ones across oceans, technology has become very practical and beneficial to our lives. Within the marine safety world, technologies are being developed that greatly enhance at-sea safety and survival. Systems such as: AIS, COSPAS SARSAT, GPS, VMS,VHF, SSB, commercial satellites along with equipment such as epirbs, AIS beacons, satellite communicators, PFDs, PLBs, strobes, LEDs, lasers, electronic distress flares, radios, signal mirrors, and even wrist watches have evolved to become equipment that greatly improves safety for people in maritime professions. This poster presentation shares info on current and upcoming technologies that are assisting NMFS observer programs with keeping at-sea observers safe.

A Philosophy of Play: the difference between surviving and thriving at sea

Emily Miller

Frank Orth and Assoc. Observer, USA

When it comes to living as an observer does, the prevailing sentiment is “it’s not for everyone.” The challenges we face are not limited to those they share with the fishermen – those of inclement weather, tight quarters, and long hours. The mental and emotional strain is equally substantial, and slightly more slippery to address. By nature of the job, an observer will always be on the outside of whatever social dynamic existing on board the vessel. Whether he or she faces outright hostility or is simply ignored as a symptom of a language barrier, the effects of isolation take a toll, and are compounded by whatever hazardous conditions the physical environment might pose.

The result can be an unhappy, stressed individual, unlikely to repeat a season observing, and unlikely to have much energy to improve relations between observers and fishermen. But this is not necessarily the rule – there are certainly observers that enjoy their work, risks, challenges, and all. While the commentary “it’s not for everyone” is certainly true, this sentiment does not distinguish what factors might be at play in determining who thrives, and who merely survives, their time as an observer.

This mysterious intangible exists in the workplace culture of some of the most stressful careers, and also in the against-all-odds survival stories of people escaping perilous environments. It is something we are born with, and only learn to forget. And it takes the unassuming form of humor, and a sense of play. As it turns out, the ability to play indicates a willingness and readiness to take on the most difficult situations, because people in play mode perceive stress as a challenge, not a threat. Academic findings on the social and neurological benefits of play suggest that it allows the practitioner to make better decisions, act with empathy, build trust, and stay motivated, among other advantages. All can be valuable for the well-being of an observer.

Once identified as a factor, play can be cultivated and encouraged on a professional level, provided we can overcome the irony of placing the two together in a sentence. With support from management, the opportunity exists for observers to incorporate its philosophy into their lifestyles, and disembark from long stints at sea in higher spirits than they have in the past.

Session 9. Technology used by observers

Leader: Amy S. Martins

Increasingly, observers rely on technological tools to improve data collection, efficiency, personal safety and other workplace issues. There are lessons to be learned from observer programs about different technology choices, in particular experiences with their integration and the benefits achieved. The focus of this session was on the operational impacts of technology, rather than specific features of the technology itself.

Oral Presentations - Extended Abstracts

Lessons Learned by Advancing Data Collection with Electronic Applications

Kevin Romanin

Archipelago Marine Research Ltd., BC, Canada

Archipelago has worked with fisheries monitoring data for over 35 years and is constantly striving to improve data quality, efficiency, and delivery within our fisheries monitoring programs. Field staff demands for better tools along with client demands for efficiencies to decrease costs have led to the development of mobile data applications. Archipelago currently provides services for 10 domestic fisheries monitoring programs in BC and is currently using 5 mobile apps developed in-house, as well as additional apps created for the Trawl fishery by a 3rd party (Vericatch). In creating multiple apps and managing their usage in the field, Archipelago has learned many valuable lessons to share with those considering a move to e-data capture solutions. Launching an application to field staff or fishers has its challenges, which have been quickly outweighed by the rewards.

One of the very first steps to starting the development of a new app is selecting the operating system (Android, Windows, or IOS). Archipelago has chosen Android for the programming flexibility and more accessible costs for tablet devices. The devices we've found most suitable for data entry applications have been 10 inch tablets with a rugged case. The android tablets come loaded with various other tools that we've utilized in data collection and app management such as the internal file storage for backing up files, the calculator, the camera for species ID or reporting safety concerns, and the play store for running apps through to ensure that updates are done automatically. We have also used the security features as an extra layer of data protection as well as enabled the ability to remotely wipe a tablet if it is stolen.

Replacing any paper dependent data system with an electronic one provides real-time data quality and reporting while eliminating simple calculation and transcription errors. Data quality can be built into apps in various ways like automatic calculations, summary reports, and pop-up warnings about the type of data entered or if data is outside of an expected range. Any efficiency made for data quality or data timeliness has great benefits when considered across thousands of data collection events. Having real-time reporting also allows observers or fishermen to periodically check for data errors as well provide instant data summaries. The apps can also include various levels of customization including preferences that can be toggled on or built in exceptions that affect certain data fields when specific fisheries or vessels are selected.

Here is a brief summary of the lessons we learned in developing apps that could help with anyone else working on a similar project:

Lesson 1: The foundation of our approach to app design is having an informed development staff design an app from the user perspective instead of the data structure requirements. The app in the end is a tool for data collection and the tool needs to be easy to use as well as desirable to use. Modeling the data entry screens and collection methods after the end user's data will make their life easier and will increase the uptake especially in situations where using the app is optional. Involving end users in the development process is key to understanding the little things that make big differences to them.

Lesson 2: The feedback loop between the users and developer must also be carefully designed and managed. Creating a standardized method of reporting and testing bugs ensures a quick and confident roll out of any changes. We maintained a priority list of failures, problems, and preferences and made sure the developer was working on them in critical order. With every bug report during the testing and roll out phases you need to make sure that the version of the app and the device they are using is reported to make sure the version is current and that there aren't differences between the way various devices work with your app. One important part of the feedback loop was getting the developer into the field to see the environment and how the data was being collected to better guide how the functionalities were being programmed.

Lesson 3: Design the app for those few people that claim not to be tech savvy and don't like change. Like any big shift, moving from paper to digital can be intimidating to staff or fishers and there are always several who claim they won't be able to use it regardless of how it works or say they dislike it before they've even tried it. By getting their feedback and keeping them in mind while designing all aspects you can create intuitive functions within any app that will result in an app even they can use and enjoy. Do not get frustrated with them, but instead engage with them and realize that their feedback has some of the highest value.

Lesson 4: Planning the support network is important to keep an app going and maintaining it as an enjoyable tool to use. It was key for us to maintain someone as the main point of contact between the developer and the end user to make the decisions about whether each change was something required to be programmed into the app or something that the observers would need to accommodate. That point of contact can also handle calls about troubleshooting or walkthroughs of basic usage despite making a clear instruction manual. Making sure to keep current documentation is also critical as apps tend to evolve quickly at first. It is not worth starting the how to manual early in the process as it changes to constantly, so we waited until most of the app was settled before starting the manual and had to make sure to update it with every change to the app. Another major part of the support network which was unexpected for us was the amount of support we would have to provide for the device’s operating system. Make sure your point of contact is well trained on how your selected operating system works.

Lesson 5: Last and most importantly is to protect the data. There is a realistic fear that digital data can disappear unexpectedly due to app failure or other technical problems unlike trusty paper which would only be lost if physically destroyed. We developed multiple means of data back up to servers and to the internal storage of the tablet directly to prevent data loss. Emergency protocols were also developed in case apps crashed and data backups were created in case of user accidental deletions. When rolling out a new update we made sure to have the most recent stable version ready to deploy in case there was an unexpected bug that slipped through testing and made sure to only roll out new changes early in the week to give time to catch problems before the weekends when there is less available support.

In the end, the paper tally forms and calculators that observers use to collect data are tools, and so are mobile data apps. If you ever expect someone to trade an old familiar tool with a new one you need to make the new one desirable to use by offering something more than the previous tool did. It must make their job easier and they must want to use it. To build an app that does this, it must be designed for the end user and incorporate the features that are important to them. It also must be reliable by not losing data or frustrating them by constantly having bugs and features that don’t work well. It even needs to have an element of marketing built in to sell it to the end users with the little details that can have huge impacts on uptake such as screen layout, button and font sizes, simple slide or click functionalities, and nice color schemes. Mobile apps will continue to expand the innovative possibilities for efficiency and progress the ability to process data at the point of collection making them an important continuing trend in enhancing fisheries data services.

E-reporting – the PNA Experience

David Byrom

MRAG Asia Pacific

Development of an android based e-reporting application for Parties to the Nauru Agreement (PNA) observers commenced in 2014 with at-sea trials carried out in 2016 and 2017. The technology for observers to report in near real time is now ready, operating and available for PNA Observer Agency observers operating in the Western Pacific Ocean. Observers have the capability to use tablets to input data into e-reporting forms using an android application. The tablets are connected via bluetooth to a personal satellite communication device which sends encrypted data to the PNA FIMS server, providing fisheries managers the option to see observer data in near real time.

The ability to speed up the delivery of observer data to fisheries scientists and managers is a substantial improvement to the information transfer system in regional fisheries management. Real time knowledge of what is happening in the fishery has the potential to increase the ability to make effective decisions based on up to date scientific advice.

Verification of vessel e-logs of fishing activity and catch can now be monitored on a daily basis, vessels reported activity can be checked electronically and “flagged” in the event of a contradiction into what’s being reported by the vessel and the observer.

Prior to the use of In-reaches and e-reporting in the region, observers used vessel email to communicate with shore-based managers. The system was insecure and the vessel operators had access to all the observer communication, potentially putting observers at risk. The new connectivity allows observers to communicate securely and economically with shore-based observer coordinators on a regular basis.

The current paper-based system for data collection is laborious, expensive and the transfer of observer information into the regional database is long-winded. The data is collected and written into the paper workbook, on arrival on-shore and after debriefing the workbook is scanned and saved to an online folder, before entry into the database by shore based data input staff. The duplication of the input of the data can lead to error. Internet in the region is not conducive to moving large volumes of data, quality of scanned data has been problematic and the whole process can take months to complete.

The costs of purchasing the workbooks and freighting and distributing the packages around the Western Pacific is an expensive exercise. With the development of technology and decreasing prices of android tablets, it is possible to exchange the budget allocation for workbooks for the purchase of tablets. The lifespan of tablets in the harsh conditions for electronics on fishing vessels in the humid Pacific climate is two year maximum but the cost of replacement easily equates to the cost of the workbooks.

The amount and type of data transmitted by the observer can be modified to suit the real time information required by the fishery managers. Data costs can be prohibitive so it is also possible to save data for the observer to upload as soon as the vessel arrives in Wi-Fi range. Documents and photo’s are generally saved by the observer for upload on arrival in port, but daily trip statistics on catch and compliance are uploaded in real time. Initial purchase of the e-reporting tablets and satellite devices was funded by WWF and distributed throughout the PNA region; data transfer costs have been supported by the PNA Office. Moving forward, the ongoing costs of operating the system will be cost recovered from the fleet.

Trials were carried out throughout 2016 and 2017 with constant modifications made to the FIMS application, developments are ongoing and a new online debriefing module has been developed. The application is now being used on a daily basis with near real time data being submitted by observers.

Despite the availability of the technology, application and the equipment, uptake of e-reporting has been slower than expected. Logistics of moving equipment around has proved difficult, observers are happy to continue to use the tried and trusted paper logs, less technology savvy coordinators are apprehensive of the application, minor hiccups and technical glitches become major hurdles and “change” takes time. To date, around 100+ FSMA e-reporting trips have been carried out in 2016 and 2017, equating to only 10-15% of the total.
The target for 2018 is to achieve far higher levels of e-reporting trips and to remove paper-based reporting completely by 2020. A comprehensive training program is being carried out (supported by the Global Environment Facility) and greater resources are being directed at implementation and roll out of the program. The training program was initially centred on a

workshop type environment and proved effective in the basic knowledge transfer to observers. It is now becoming apparent however, that to increase the uptake in use of the equipment, some dedicated intensive one-on-one training is needed for most observers to assist in setting up the system and to feel comfortable in the use of the e-forms. On-shore support from a dedicated e-reporting officer and full-time assistance in training and supporting e-reporting is starting to show good results. More e-reporting trips are being taken up as observers are becoming more confident in the technology.

The challenge to bring about change is being tackled with innovative solutions and the move to technology-based reporting is being supported at the highest level. Further new initiatives and ideas are being put forward for development in the e-reporting field, however the technology is moving faster than practical implementation can support. Transition from paper based to e-reporting is taking time and effort, but there is a gradual and unstoppable shift to the digital world of observer e-reporting in the PNA region.

E-reg – Electronic Registration application for data collection in aquatic ecosystem monitoring

Mikael Ovegard

Swedish Universityof Agricultural Sciences, Sweden

E-reg is an in-house developed software application used at the Institute for Marine Research, Department of Aquatic Resources, Swedish University of Agricultural Sciences (SLU Aqua). In its current version the application is used for data collection on national coastal trawl surveys, the Baltic International Trawl Survey (limited to the small vessel survey in the Sound), on-board sampling of commercial pot fishery and on-board sampling of commercial bottom trawl fishery targeting fish and/or Norwegian lobster.

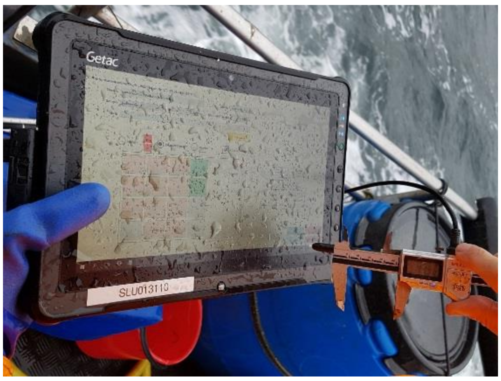
The overall goal of the E-reg project is to “implement electronic devices for assisting the biological data collection of fish and shellfish”, i.e. finding methods that reduce the need of pen and paper in data collection. In recent years the Marine Strategy Framework Directive and the move towards ecosystem-based assessment have increased the demand on cost efficiency and the need to use long term monitoring programs of fish and shellfish communities for data collection of other components of the ecosystem. Collecting data in a digital format makes it possible to meet these demands and increase the data quality by applying real-time computerized quality controls, increase the data tractability, eliminate transcription errors and contribute to a higher collection rate.

When first initialized in the fall 2014, the E-reg project manly focused on finding commercially available electronic tools, such as measuring boards, calipers etc. However, after evaluation of the usefulness of these tools it was obvious that there was something missing. Without a receiving software, where the user can “tag” the electronic measurements to a specific trip, station, species and/or sample the tools were of limited help. As a consequence, the project shifted to finding a suitable software and hardware platform for registering all types of data that are collected in the field. Focus was no longer on just biological data, the users also need to be able to digitally enter information concerning the sampling location, gear type, sampling targets etc. A rugged tablet was determined to be the best hardware option, different registration software's were evaluated, but since none of the commercially available products suited the needs of the users it was decided that SLU Aqua should develop its own data collection application.

System overview

The E-reg application uses Microsoft Windows OS (64 bit) and a Microsoft SQL-server database (local installation on tablets). The user interface is specifically designed for touchscreen tablets, i.e. efforts have been made to reduce the need of mouse and keyboard for entering data and navigation within the application. Pre-configured workflows based on sampling type and sampling targets also reduces the number of actions needed to enter a value. Currently, SLU Aqua uses the Getac F110 tablet for all data collection with this application, however, E-reg have also been tested on Panasonic and Dell products with success. Different brand of rugged tablets, calipers, scales etc. have all some limitations. For a future safe system it is important to be able to switch product when something better becomes available on the market.

The application consist of several types of individually configurable registration pages designed for entering specific type of information. "Trip page" is used for entering information such as sampling type, vessel, responsible etc., "Station page" is for selection of gear, position data etc., and so on. The user can at all times move freely between the different pages, however, depending on selection of sampling type and the configuration of sampling target the application also guides the user to specific work tasks by automatically move between the pages. If the user enters a length of a fish that, according to the sampling target, should be individually sampled for weight, sex and maturity the application jumps directly to the specimen sampling page where values for these parameters can be entered. Although the goal is to use electronic tools connected to the tablet for the data collection whenever this is possible, requested values can at all times also be entered "manually" by using a digitizer-pen and the tablets touchscreen. At the time of writing the E-reg application utilizes the internal GPS receiver in the Getac tablet for collection of date, time and position and electronic calipers for measuring the carapace length of Norwegian lobsters. Possibility to incorporate electronic scales and some type of measuring board for collecting the length of fish are currently under development.



Picture shoving the E-reg application on a Getac F110 tablet with USB connected caliper.

For more details and a view of E-reg in action please visit: https://youtu.be/rqO_3zquMcM

Lessons learnt from developing the system

The initial cost for developing an in-house system is higher compared to most available commercial products. Time to implementation and return of investment is also longer.

However, when the system is in place the cost for maintenance is likely to be lower (no licenses to pay). Since it will be developed and fitted to the specific need of the owner it will likely also be easier to implement and give a higher return in efficiency. Implementation can also be facilitated by allowing the end users into the development process on an early stage. This will give them plenty of time to influence the design and to get use to the upcoming changes.

Future implementations

Although the E-reg application have been proven to work in the challenging environment of small survey vessels and in sampling of commercial fishing vessels there are still room for many improvements, especially when it comes to connected hardware. Finding appropriate electronic tools, that are adaptable and portable, for measuring the length and weight of fish and shellfish have been proven harder than expected. For this reason SLU Aqua is currently developing our own measuring board, but we hope that the IFOMC will be a venue for finding suitable products. Apart from expanding the current data collection with the E-reg platform to more sampling trips on-board commercial vessels, the design and functions of the registration forms in the application will also be incorporated into the data collection software developed for R/V Svea. If all goes according to plan the data collection in the fish-lab of this new state of the art research vessel will be fully electronic.

Motion Compensating At-sea Flow Scales: The Unsung Technology that Revolutionized the Way Observers Work in Alaska

Jennifer Watson[1], Brian Mason and Marlon Concepcion[2]

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A motion compensating at-sea flow scale (flow scale) weighs a continuous flow of catch as it moves along a conveyor. This technology is able to measure the total catch of fish precisely while a vessel is in motion. Flow scales were implemented in 1998 in the Bering Sea and Aleutian Islands (BSAI) in response to a need for catch accounting methods that were more precise and verifiable at the level of the individual haul. In the beginning, catch weighed on flow scales accounted for only 6% of the BSAI Total Allowable Catch (TAC). Today that number has risen to 64% of the TAC with 95% of all catch processed at sea in the BSAI weighed on a NMFS approved flow scale (table 1). Flow scales have become an essential part of the processing technology for the fishing industry enabling vessels to precisely monitor and track production as well as improve efficiencies. These scales have also revolutionized observer sampling.

Table 1

Year	Number of vessels weighing catch[1]	Total weighed (mt)[2]	% BSAI TAC
1999	20	121,000	6%

2004	23	836,000	42%
2008	42	944,000	47%
2012	39	1,100,000	55%
2017	63	1,281,700	64%
1. BSAI groundfish only, does not include crab. 2. Does not include catch weighed in the GOA, crab catch, or catch weighed in the Pacific whiting fishery off the West coast.			

Prior to flow scales, observers estimated total catch by taking volumetric measurements on deck or inside live tanks in difficult and dangerous conditions. Observers were frequently exposed to harsh weather, wires that could snap under tension, and a rolling 150 ton bag of fish to collect an imprecise data point.

Some boats did have markings inside holding tanks to allow the observer to obtain an estimate without going on deck, obtaining the readings was often difficult because it was hard to see through the scratched Plexiglass and fish never piled up evenly.

Now flow scales obtain the total catch weight for each haul and observers stay safer inside the factory. Observers simply monitor the daily flow scale test for accuracy.

The location for an observer to collect a species composition sample was frequently afterthought for the vessel and more often, the observer had to cobble together their own way to collect and work up these samples. Observers sometimes had to hang their baskets at the end of a conveyor belt to collect samples, hoping not to drop the basket. To weigh the samples, observers used spring balance hanging scales that swung wildly in any sea besides glass calm waters.

A known weight of material must be used to test the accuracy of the flow scale. To determine that known weight flow scales are coupled with a motion compensated platform scale. This was the birth of the observer sample stations. All vessels with a flow scale must now provide the observers with that platform scale to weigh their sample along with a table of specified dimensions, running water, a place to store samples, and a way to safely divert catch from the flow of fish.

Finally, the observer species composition samples were fixed by the configuration of the vessel's factory. These samples were often taken opportunistically and may not have been representative of the actual catch composition. With flow scales observer are now able to collect random systematic samples throughout the haul using the readings from the flow scale.

Flow scale technology and associated duties of observers are evolving. Several future innovations are being planned to enhance the quality of data collected by observers and as well improve their work environment using flow scale technology. Specifically, aboard factory longliners observers must collect and weigh Pacific cod to determine an average weight. Because Pacific cod go over the flow scale one or two at a time, the flow scale could collect this information for the observer instead. Also, linking the scales to a wireless technology would allow sample weights to be automatically collected and the observer would no longer need to write down the results. In the coming years we hope to test both of these innovations aboard several vessels.

Oasis data entry android application for the Northeast Fisheries Observer Program

Erin E. Kupcha

NOAA Fisheries, Northeast Fisheries Science Center, Fisheries Sampling Branch, Northeast Fisheries Observer Program

The Fisheries Sampling Branch's (FSB) Northeast Fisheries Observer Program (NEFOP) provides training for and certification of NEFOP observers, Industry Funded Scallop (IFS) observers and At-Sea Monitors (ASMs). Observers and monitors collect scientific, management, compliance and other fishery dependent data aboard federal and state permitted commercial fishing vessels covering ports from Maine to North Carolina. Electronic data are collected by observers via a rugged Android tablet with a single, stand-alone native application, OASIS (Observer At-Sea Information System). OASIS was developed to allow ASM and NEFOP observers to collect data for accurate in-season quota monitoring on kept and discarded species in the Northeast Multispecies groundfish fishery. IFS and NEFOP observers also employ OASIS to collect near-real-time data in the Atlantic sea scallop, Atlantic herring and longfin squid fisheries for catch reporting on key bycatch species. Data entered and uploaded by observers are then edited, audited, and loaded to Oracle tables by FSB staff.

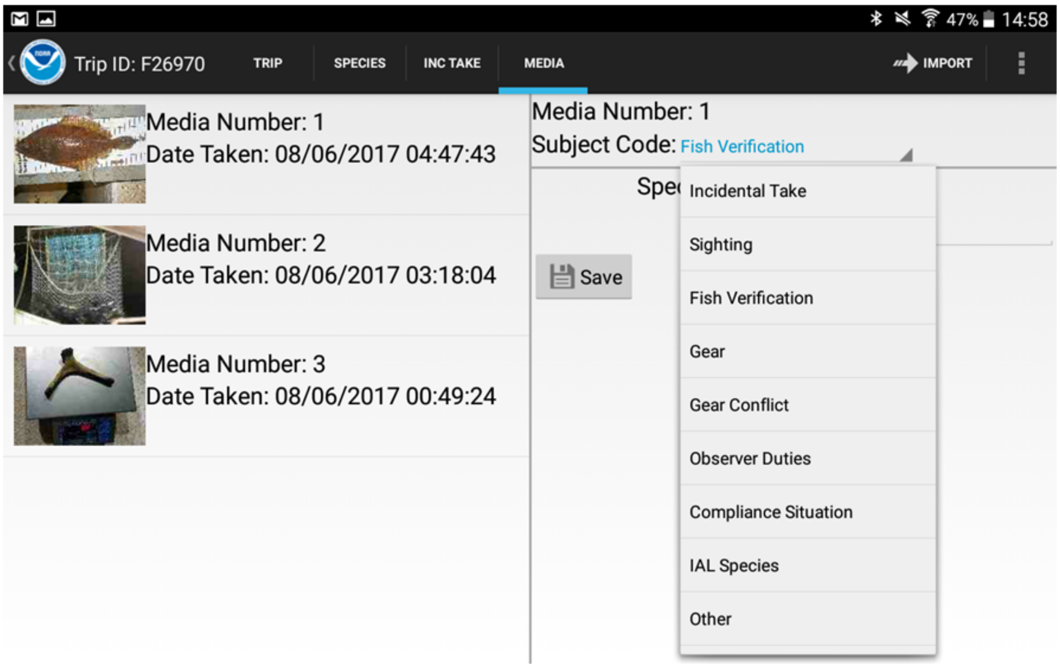
In the groundfish fishery, loaded observer data are provided daily to the Greater Atlantic Regional Fisheries Office (GARFO) fishery analysts and sector managers, and are used to calculate remaining Annual Catch Entitlements within 72 hours after the trip lands. In the scallop, herring and longfin squid fisheries, preliminary loaded data are provided to GARFO for fishery specific in-season quota and bycatch monitoring within 5 days after the trip lands.

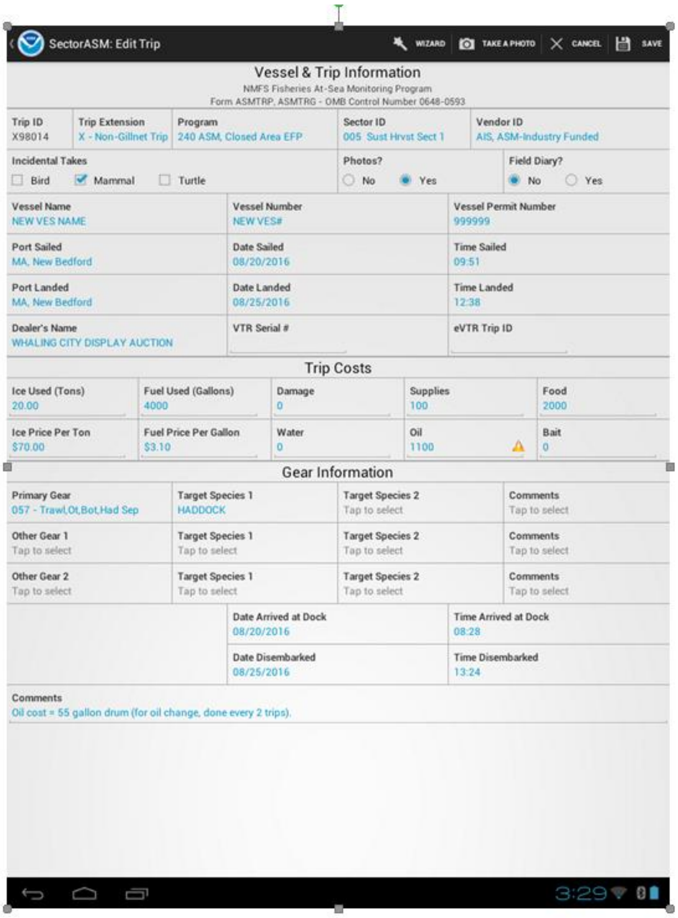
Observers and ASMs need cost-efficient, durable and rugged hardware that is equipped with on demand data communications such as GPS, Wi-Fi and Bluetooth. It is critical for the data entry software to have an user-friendly interface for quick data entry with built in data quality checks to provide accuracy. Data must be secure and encrypted. Data confidentiality is assured by hardware security that is administered by the National Oceanic and Atmospheric Administration (NOAA) Fisheries office of the Chief Information Officer.

OASIS is designed and written to be target device-independent, permitting ease of deployment for future generation platforms. OASIS utilizes integrated accessories, such as a GPS receiver which increases data accuracy and eliminates the burden of using the vessel's location devices. It also utilizes the tablet's built-in camera to encourage interactive data collection while collecting ancillary data in an error reduced, automated manner. The FSB deploys a rugged digital camera and Wi-Fi enabled SD card . The camera allows observers and monitors to take pictures and videos of relevant items and events related to their trip to enhance data quality and capture additional information. The SD card transfers media wirelessly from camera to tablet while at sea and immediately after the picture or video is captured. The gallery in OASIS collects and displays metadata for each media item and allows the observer to assign relevant attributes for each record. Wi-Fi connectivity is used to facilitate timely transmission of the data upon landing.

Observers and ASMs are guided through data entry by presenting them with only relevant data within the context of each field. OASIS provides the user with pre-defined data options that are constrained to valid information. Data quality constrictions such as date and value ranges and their relationships to each other prevent the user from entering incorrect data. Data warnings and errors are immediately visible to the user to allow them to verify the data they entered. This allows the user to correct the data if it was improperly entered or comment on the verified value that is out of range.

The FSB continues to explore new and innovative ways to collect fisheries data, providing data and accommodating change at a faster rate without compromising quality or safety. Through collaboration with other NOAA science centers we are investigating Bluetooth voice technology for enhanced data collection. The FSB is in the process of integrating motion-calibrated marine scale catch weight data directly into haul level entry screens and Bluetooth caliper data for crustacean sampling. Through enhancements and efficiencies, we are expanding the scope of data collection to other programs such as IFS and NEFOP and working toward a paperless solution.





Open Discussion Session

Q - Asked about the possibility of using voice recognition with the onboard systems, similar to the technology NOAA Fisheries utilized on the survey vessels with blue tooth technology.
A - Sweden employs Dragon speech software to translate voice recorded data and Canada collaborates with NOAA Fisheries experts who developed a Windows based operating systems.

Q - How do observers estimate catch weight in the codend when there are high volumes of bycatch using the automated discard estimate?
A - By using a tool built into the vessel, a load cell is installed on the beam of the fishing net to weigh the codend prior to discard.

Q - Regarding the use of older technology such as 'scanboards' or Scantrawl measuring boards in the Norwegian Inst. Marine Research. Are these electronic boards used to measuring length frequency in Sweden fisheries?
A - Worked with the off the shelf units and developed ones more suitable for their needs, environment.

Q - Is there is an increased potential to discard at sea if there is a reported independent weight recorded. Also, how did the crew separate the non-fish weights such as rocks or fish offal when a *live* weight is already recorded and how is the ratio of landings to discard accounted (recorded)?
A – Not captured

Q - WWF is interested in investing in technologies to improve catch monitoring. He identifies the bottleneck of implementation in an international fishery at the training level. Also how to incentivize using EM?
A - Agreed that training is a bottle neck with implementation in the international fisheries, however the opportunities are improving.

Q - As an observer, I love working with flow scales to support randomization and standardization of recorded weights. Her questions: What incentives are there to use the motion compensated scales to increase their use in commercial fisheries? Industry must be incentivized to use the technology for weight accuracy as well as enhance traceability with production of their catch to product.
A - The panel agreed that industry should be incentivized.

Q - Is it possible to fault a scale, are these flow scales tamper resistant?
A - They are tamper evident so creating a faulty weight is recorded. In 2014, new technologies were developed to enhance compliance with flow scales along with electronic monitoring to record the fault log and calibration of the scales to trace the error or a faulting weight.

Q - Asked about diversification of tools, and why observers collect all the data.
A - Commented about the upcoming NEFSC data summit for the science community (including observers) to get feedback from the data collectors as well as discussion about the need for the data from the data users.

Q - He had referenced a disposable table in his talk, what is a disposable table?
A - They found that using a less expensive tablet or 'disposable' (compared to the cost using a rugged laptop) still met their needs, and these tablets paid for themselves within 2 to 3 trips.

Q - Asked if there is a tablet that can survive on deck for longer than 3 hours?
A - Response was to encourage sampling in warmer climates, another speaker suggested using a Panasonic tough pad with a long battery life.

Q - Looking for cost analysis for some of the technologies presented at this session to assist with balancing the cost of including this technology in his program.
A – Have researched several units to find the least expensive depending on the number of units purchased. MRAG worked with industry for cost recovery on the purchases of hardware for their vessels.

Poster Presentations – Extended Abstracts

An Observers Perspective: Transitioning to Paperless Electronic Data Collection

James Grunden

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Introduction

Advances in mobile technologies are driving a transition from traditional methods of data collection to electronic paperless data acquisition. Reorganizing methodologies of a dataset can be costly and time consuming, especially if there are uncertainties about platform compatibility and applications in the field. In 2017 the West Coast Groundfish Observer Program (WCGOP) began its shift to paperless data collection with the rollout of the OPTECS back deck software and tablets. The purpose of the poster is to document the transition process and share the challenges and experiences with others who are planning on going paperless.

Tablets Overview

The WCGOP decided on testing two rugged outdoor tablets with the hope of acquiring the best device on the market. The tablets compared are the **Getac T800** and the **Panasonic FG-Z1**. Both host a list of competing features such as screen size, weight, battery life and accessory applications along with waterproof and shock specifications.

Software

The Observer Program Technology Enhanced Collection System (OPTECS) software acts as an offline version of our database and was designed to follow information you would expect to enter at the time you enter it, allowing data entry to follow the events on deck. The software is backed up externally on a thumb drive and synchronizes with our online database to upload data with Internet connection.

Accessory stand

This lightweight aluminum stand breaks down and is able to fit in an observer's basket. Once assembled the stand attaches to the legs of the scale so as not to interfere with weights and allows the tablet to be hands free so the observer can process samples and enter data freely.

Tablet Comparison

The **Getac T800** had a more compact, ergonomic design and the touch screen was more responsive, allowing the software to run faster. The port covers appeared to be more durable and there were fewer voids for salt to accumulate. The average daily battery usage was 33% and although there was a water intrusion I believe this was due to observer failure and not the tablet itself.

The **Panasonic FG-Z1** had a larger and brighter screen, which made entering and reading integers easier. The average daily battery life was 26%, which is less usage than the **T800**. The touch screen did not responded as quickly which slowed sampling on deck. The port hatches appeared flimsy and could be a possible failure point after extended use. Condensation did occur on the barcode screen and the tablet had numerous voids that would collect salt.

Software Compatibility

In the process of field-testing the software we ran into several bugs and compatibility issues. These include software bugs like certain information not appending, synchronization issues with our existing database and software crashes. These occurrences were carefully documented by observers in the field and reported to IT technicians who would resolve problems with updated software versions.

Sampling Conflicts

Sampling conflicts consisted of mostly extra time spent navigating and entering data into the software relative to paper data collection. When I began testing the tablets data collection would take about twice as long as paper. As using the tablet progressed so did my speed entering data, so now collecting data on the tablet takes longer, but is comparable to paper collection.

Discussion

Initially I was skeptical that the outdoor tablets could withstand the rigors of commercial fishing and thought the software would interfere with my sampling procedures. Although there were setbacks the tablets and software outperformed my expectations.

- The Getac T800 tablet held up better in the back deck environment and the OPTECS software was quick enough to be comparable to paper sampling with a little practice
- Software compatibility issues were quickly identified by staff and resolved with software updates
- Time spent transcribing and entering data was reduced significantly. Trips that could take 4 hours to enter can now be completed in 30 minutes

WCGOP has deployed 11 additional tablets to observers for testing and is designing a fixed gear version of OPTECS software with hopes of expanding tablet use to all sectors of the program.

Creating more accurate and timely data with the paperless At-Sea Monitoring study

Ashley Traverse-Taylor[1], Debra Duarte[2]

[1]: Integrated Statistics, Woods Hole, MA, contracted to Northeast Fisheries Science Center
[2]: Northeast Fisheries Science Center, Fisheries Sampling Branch

In 2010, the At-Sea Monitoring Program (ASM) was developed in the Northeast United States, which focused on collecting detailed catch information in the Northeast multispecies fishery to be used for quota monitoring. Changes in 2010 to the Northeast Multispecies Fishery Management Plan (Amendment 16) required quota monitoring by the Northeast Fishery Management Council. The council stipulated that the ASM program be required to have real time data submission. These stipulations required the traditional data processing be updated through monitors entering data while out at sea. In the beginning stages of the ASM program, the data was collected on paper logs then entered into the iPAQ handheld device. As seen in Figure 1, an analysis was conducted to compare the number of data entry errors using the iPAQ in 2013 versus the Toughpad in 2015.

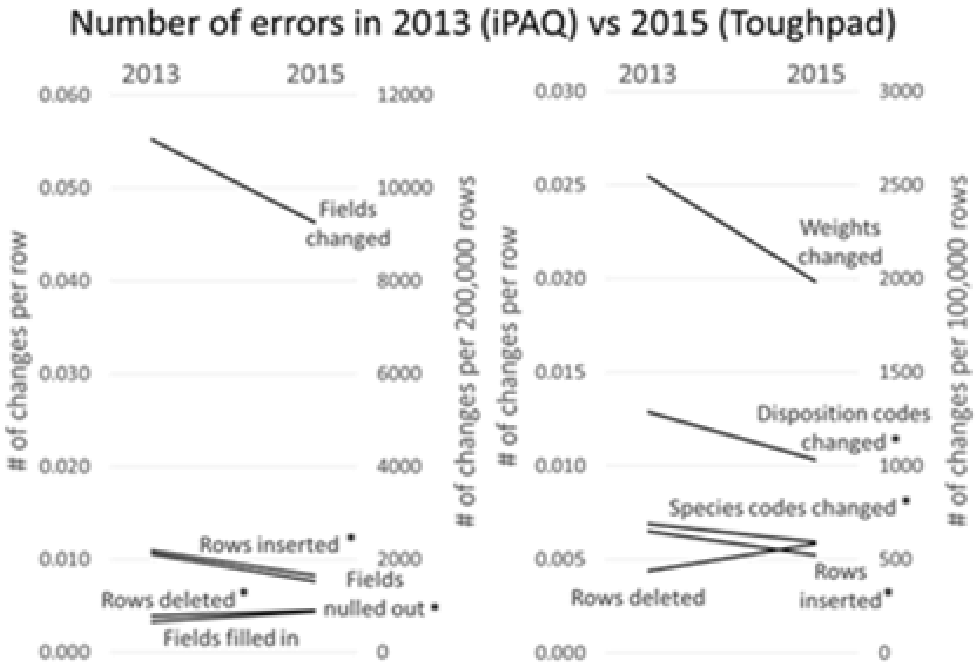

Figure 1: Number of errors in 2013 (iPAQ) vs 2015 (Toughpad).
Left: changes for all data elements; right: changes for the species data. Error rate is displayed as per database row (left-hand axis) and per year average (right-hand axis). Asterisks indicates significant change between years ($p<0.05$).

This analysis indicated that there was a significant decrease in the number of errors between the iPAQ and Toughpad. Given these results, the paperless pilot study was implemented to determine the feasibility of going completely paperless and entering the data directly into the Panasonic Toughpad. In April 2016, the first phase of the paperless pilot study started with nine observers who maintained high data quality. Phase One consisted of entering data into the SectorASM entry program on the Toughpad with Android application transcribed from a waterproof notebook, worksheets, and/or length strips. The pilot monitors still had some logs that had to be sent in within four business days and formatted completely as there was no comparable electronic system at the time. Worksheets that were used for calculations were not required to be formatted; however, they were still required to be sent in for validation. A Pilot Study Questionnaire for the pilot monitors were required for each trip, which allowed staff the ability to better evaluate the paperless data collection system. Phase Two was a rolling phase throughout the year which included 41 monitors that were actively taking ASM trips with no constraints on level of data quality except excluding monitors with very low data quality. After Phase Two began, the monitors were issued Samsung tablets with Android application. As of 9/25/17 there were a total of 256 paperless trips with 107 questionnaires. Figure 2, displays the error rate for each participating observer prior and during the paperless study.

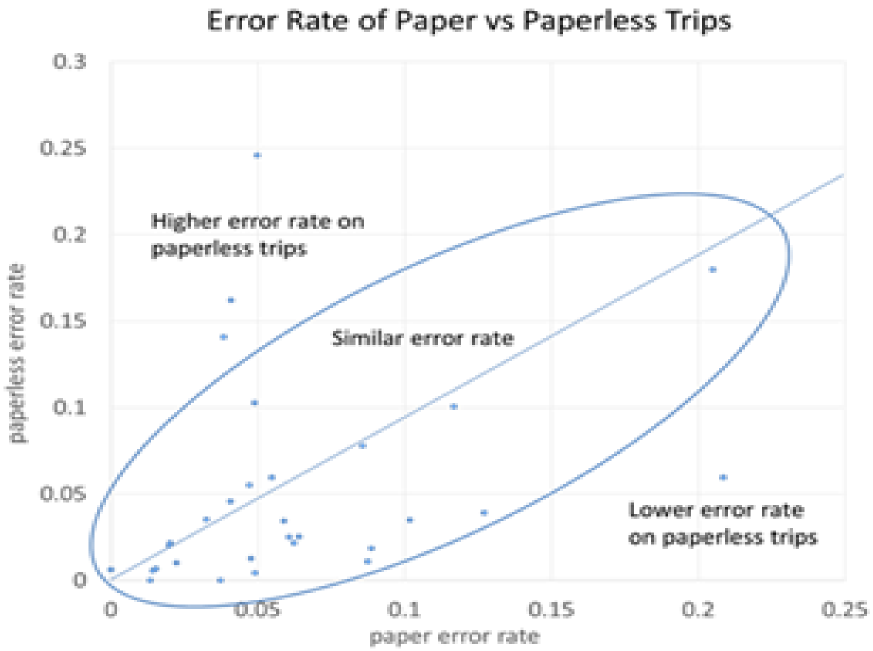

Figure 2. The error rate comparing recording directly onto paper with recording directly into the Android application. Top left: Higher error rate on paperless trips, re-evaluate if monitor should go back to paper logs. Middle: Similar error rate for paper and paperless trips. Bottom right: Lower error rate on paperless trips, may be missing errors and would need to check against waterproof notebooks and re-evaluate if monitor should go back to paper logs.

The results show that there is a similar error rate between the paper and paperless trips. There were a few outliers with a higher error rate on paperless trips. There was one outlier for a lower error rate on paperless trips; this could be due to missing errors and would need to be checked against waterproof notebooks. Both outliers might indicate that the monitor is not ready for paperless collection and should go back to paper logs.

The results from the Questionnaires showed that going paperless: saved time, reduced redundancy, was more eco-friendly, and provided less processing time once the information was entered and uploaded into tablet. After these results, Phase Three was introduced during an ASM cross-training of observers who were already certified in either the Northeast Fisheries Observer Program (NEFOP) or Industry Funded Scallop (IFS) programs. The monitors used paper logs during training and on their four certification training trips, but had the option to use the paperless format after they were certified and their data met minimum data quality standards. In May of 2018, the Fisheries Sampling Branch held an End User Data Summit. One of the goals of this meeting was to streamline the data collection across all programs in the Northeast. This will make the transition to paperless in other Fisheries Sampling Branch programs in the future possible. The pilot paperless study showed the feasibility of paperless data collection for ASM's in-the-field conditions. The next steps to transition to a full paperless system are to develop the training program and to have all remaining logs available on the tablet application. This study has provided background knowledge on what steps it would take moving forward in the implementation of the paperless ASM program.

Nephrops electronic data collection

Peter Gibson

Marine Scotland Science, UK

<u>Introduction</u>

The fishery for *Nephrops* around Scotland began in the 1960s and is currently the second most valuable species landed in Scotland. There are *Nephrops* fisheries on grounds around Scotland with the largest being the Fladen grounds in the North Sea. Most *Nephrops* are caught by trawlers in mixed fisheries but the creel fishery is also important particularly on the west coast.

For the purpose of stock assessments, *Nephrops* around Scotland are split into a number of stocks or Functional Units. Within these functional units are muddy patches of seabed which are the preferred habitat on which they live. The stock assessments, which are conducted by ICES, require information on *Nephrops* fishery size composition and discard rates. These data are obtained through a combination of on-shore (market) sampling, covering the landed component of the catch, and at-sea (observer) sampling of the total catch. Here we provide an overview of the data collection system utilised on observer sampling trips.

<u>Methods</u>

The MSS observer sampling programme began in the 1970s and was extended to cover *Nephrops* in the 1980s. The current programme involves 10 staff who carry out around 90 trips between them over the course of the year. Each trip typically requires between two and ten days to be spent at sea on a commercial fishing vessel collecting data on fish and shellfish being caught during normal fishing practices. Vessels range in size from under 10 m *Nephrops* range fleet working closer to shore and the larger boats up to 25 meters working the Fladen and Devils hole grounds.

Once a haul comes on board the crew will start to process the catch, ‘tailing’ some individuals and sorting the remainder into different size categories for marketing purposes. The number of categories varies from boat to boat but usually includes one category of ‘tails’ and anything from one to five sizes of whole *Nephrops*.

MSS protocol for measuring Nephrops is to measure 200 individuals per category by selecting a random corner of the box/basket after the crew on-board have selected the catch into the size selection used on that boat. In cases where *Nephrops* discarding occurs, this component of the catch is sampled in a similar manner (Note that although Nephrops are covered by the EU landings obligation (EU,2015), a de minimis exemption currently allows for discarding at a low rate to continue).

Traditionally MSS observers have used waterproof astrofoil boards and pencils while on-board to record the size composition data. This involves measuring 5-6 individuals and then marking them down on the board until the target of 200 for each size category is met. Other details relating to date, time and position of shooting and hauling can be recorded on the boards but is usually recorded in the observers note book.

For a number of years now observers have been making use of new technology to record the data. The current system involves the use of a set of electronic callipers connected by a data cable, to a digital recording device. Once an individual is selected its measurement can be recorded by pressing a button on the callipers which then transmits the recording to the digital device. The device can be set up to give an audible beep every time a successful recording has been made. Within the digital recording device software has been developed in house to allow information relating to boat name, sex, length graded category (When changing between size categories or sex the observer has to choose from a drop down menu on the screen) of *Nephrops* can be recorded.

Further developments have been made to this recording method by updating the IT hardware to a Dell Venue Pro 8 and adding in functions such as histograms to allow observers to visualise the data that have been recorded.

Once a trip has been completed, the data recorded on the Dell (length frequencies and sex) can be transferred to electronic workbooks which have been developed in house. This workbook consists of a number of excel spread sheets for recording different aspects of the trip. The front summary sheet will identify the vessel, PLN and date of start of trip as well as the end. A number of other observations are included on this summary sheet relating to area fished, trip ID number, time spent on fishing and the amount of *Nephrops* landings for that trip.

A chronological sheet within the workbook records information relating to date, time and position of shooting and hauling positions along with the numbers of discards and landed *Nephrops* for each haul. The amount of fish retained or discarded can also be recorded on this sheet if required. At present this information is recorded in the observers notebook and then transferred into these spread sheets but we aim to incorporate this function into the Dells.

The most important sheet relating to *Nephrops* in the workbook is the observer data sheet. This is where the data recorded on the Dell can be imported into the excel spreadsheet which automatically populates the appropriate size category and calculates the sampled weight.

Other parts of the workbook record Information relating to Protected, Endangered, Threatened Species capture (PETS), cost relating to trip and fish landings summary.

Many parts of the workbook are linked by basic formulas within the excel spread sheet so that an entry only has to be made once and it populates different sheets

<u>Future Developments</u>

We are currently developing the electronic data recording system to incorporate a Bluetooth function. This has already been trialled in the lab and in some limited field work with initial results being positive. By using the Bluetooth function we can eliminate the wired part of the system which is prone to damage. This use of Bluetooth also leads to increased mobility with the Dell potentially being able to be placed up to 15 meters away from Bluetooth callipers. The wired calliper set up in a protective case is already used for measuring brown crab, lobster and velvet crab during visits to fish processors The ability to place the Dell in a more secure location away from boxes of shellfish will be an added protection for the device.

The system is currently not used for recording data on scallops which require both length and age to be measured. In future we aim to develop software which has this capability.

<u>Conclusion</u>

Data collected on the MSS observer programme are an essential part of the stock assessment requirements for Scottish *Nephrops* stocks. By moving from from manual to electronic data recording means data recording is more efficient and accurate. The technology used to record these data is becoming increasingly available and affordable.

NEMESYS: An electronic data collection application for on-board fisheries observers on the Irish *Nephrops* directed fishery.

Helen McCormick, Chris Allsop, Jennifer Doyle.

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A key objective of fisheries research is to provide good information on the state of fish stocks. This information is collected through various sampling programmes and the data are used to provide advice on the sustainable management of fish and shellfish stocks, upon which the industry depends.

On average approximately 8,640 tonnes of *Nephrops* were landed between 2014 and 2016 which were worth € 60 million annually making it Irelands most valuable species.

Nephrops norvegicus is widely distributed on muddy substrates throughout the north-east Atlantic from Iceland in the north to Morocco in the south. Around Ireland they are found in depths from 20m to 600m but mainly at average depths of ~100 m on the shelf. They construct shallow burrows in muddy sediments which limits the distribution. *Nephrops* larvae hatch late spring/early summer. The females leave the burrows to hatch the eggs and mate. The eggs take about 4-8 weeks to develop into juveniles depending on water temperature. For the remainder of the year mature females then spend the majority of time in their burrows first to spawn the eggs and then incubate them. Male *Nephrops* are more active outside of the burrows foraging for food. Unlike fish, there is no direct way to age *Nephrops*. Growth rates vary considerably in different areas. Mean size is negatively correlated with density of individuals. The maximum carapace length recorded for *Nephrops* is a male of 9.3 cm from the Porcupine Bank Irish sampling programme

In 2002 the Marine Institute developed NEMESYS which is an electronic data capture software for collection of data on *Nephrops norvegicus*. This was initiated in order to move to paperless sampling of *Nephrops* in the ports, laboratories and on board vessels, where at that time to work up a *Nephrops* sample would take two samplers approximately four hours and then additional data entry and validation time approximately two hours.

Using NEMESYS it is now possible to work up a sample in the similar amount of time but with a minimum of one sampler and where the main advantage is data can be quality controlled by the samplers in situ. Once each sample passes quality control it can be uploaded to the central database server and then ready as verified data for the next step in the analyses. This electronic data capture system consists of digital electronic callipers. *Mitutoyo U-Wave USB, Mitutoyo Serial* and *Sylvac/WEL Bluetooth* Callipers are used and it is connected to a Windows based ruggedized tablet with NEMESYS software. Automatic collection of Weight Measurements with the Bluetooth Marel M2200 Weighing Scales during Length/Weight Measurements has recently been developed.

Since 2010 the only source of sampling data for FU16 Porcupine *Nephrops* stock is observer data from *Nephrops* directed trips. This data is essential to calculate mean weights which is a key factor in calculating stock abundance. The observer measures each grade of *Nephrops* before it is frozen by grade on-board using the NEMESYS system. Live readouts of carapace length measurements, a live length frequency graph and optimal sample numbers targets are displayed on the ruggedized tablet which allows the observer to quality control the data on the fly. Since 2010, 97,213 individual measurements have been taken by the observers on these trips. Typical numbers measured on a 10 day observer trip averages 6000 individuals.

Migration to OPTECS Introduces Positive Changes in Sampling Flow and Observer Life.

Eric Brasseur

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<u>Abstract</u>

The North West Fisheries Science Center's Fisheries Observation Science (FOS) program is in the process of migrating from paper data collection on trawl vessels to direct tablet data entry. Initial introduction of tablet based sampling indicates that observers will spend more time on deck at first, until they become conditioned to the new process, and will in turn see a significant reduction in time spent with post data collection duties such as cleaning and drying forms, performing calculations and transcribing data. When not engaged in sampling, observers will be able to undertake additional program duties, devote more time to computer maintenance and data security, and have more time to rest, resulting in a safer work experience.

The Observer Program Technology Enhanced Collection System (OPTECS) software was designed to complement and direct observer sampling rather than rely on mirroring a paper form. The software is split up into sections based on how the observer would encounter the data. This natural flow allows the observer to sample quickly and move from task to task fluidly. During testing one observer noted that entering paper collected data, with the app

on a tablet, was simpler than entering the same data via the web portal, attesting to its usability. We expect to discover further enhancements to the software flow after a limited rollout to a broader user base and will incorporate user experience based improvements in a second version.

Complementing the technological changes, we have developed a stand that attaches to a Marel M-1100 scale that can be adjusted to various heights and angles to allow the observer to work hands free. This will also help minimize the risk of damage to the tablet and potential data loss, while freeing up the observers hands.

Upon return, data is transmitted to center along with a copy of the database for debriefer analysis. The observer has only to enter forms not currently available in the OPTECS software and their duties are complete. Due to the data collection methods and built in validations, corrections to the data should be minimal to virtually non existent, assuming sampling was done correctly. The program will begin to see extremely quick and efficient data turn arounds as electronic data collection expands and the debriefing process is finalized.

Background

The OPTECS project field tested and released 15 software editions between Oct 1,2017 and May 24, 2018. Each software revision addressed a newly discovered bug or improved general software functionality. Due to limitations in the sync procedure for the current WCGOP production database, many of the fixes were simple updates for tables that cannot be synced with OPTECS automatically, such as sampling protocols. OPTECS Version 1.5.2+50 is the current release as of March 28, 2018, and has been functioning very well with no known bugs or table updates required. There are currently 11 active users deployed.

Observers were selected to participate in the limited release of the system based on the recommendation of their debriefer and participation in trawl fisheries. Paperless testing of the intended final software version begin in November 2017. Two Non-Catchshare observers were deployed with a tablet, stand and software, with one Catchshare observer added\February 2018. They were asked to start entering data from paper to the tablet to allow the debriefers a transition mechanism for validating data and give them time to learn how to use the software. The observers then moved on to direct data entry after 3 paper trips and uploaded a total 44 trips using the OPTECS software during this time period. Beginning in May 2018 the program was expanded to include 9 more observers.

During this time we also clarified procedures that observers were unaware of due to the differences between paper and tablet data recording, additional baskets entry for example, and added that information to initial training details. Tablet only data collection has been going well, with very few problems encountered since version 1.5.2+50. There have been 4 transcription errors reported that occurred while copying logbook locations. Error reporting caught the mistakes but the observers either did not run the error checking function or did not make the required corrections prior to uploading the data.

An OPTECS manual was developed and distributed to assist observers and debriefers and address any potential user error issues. Field testing of the GETAC T-800 led to the purchase of 10 additional units. Subsequent testing has confirmed that we will be ordering the T-800 exclusively and 90 additional units had been ordered. An aluminum prototype tablet stand was developed, deployed, tested and redesigned. The current stand is functioning very well as is, but is prone to salt build up problems. A final simplified stainless steel version is currently being field tested. Observers noted that the stand was critical to data collection via tablet.

Methods

While a more robust analysis of the effects of transitioning from paper based data collection to electronic data collection was expected, only an extremely limited evaluation was able to be completed. This was primarily due to the small number of observers deployed with a tablet and approved to sample paperlessly, but also included:

- The software release date was pushed back due to bugs discovered during primary field testing.
- Debriefers were not ready to certify paperless data in a short period so users were restricted to Non-Catchshare users or very simple CS fisheries.
- There were few Non-Catchshare trawl trips from November to April.
- The number of tablets available was limited to 2 until April, 2018.

Five participants completed 29 paperless trips in time to be included. All participants were asked to complete a brief survey to ascertain their impression of how sampling time changed, whether they were able to get more rest at sea and or at home, if there were any effects on sampling procedures, and if they felt safer due to the changes. They were also asked to compile regular reports of their impressions, time spent on deck, and problems encountered.

Conclusions:

- 5 Observers participated, each with at least 4 paperless trips completed and a total of 29 trips.
- Observers did see an initial increase in time on deck of 15-30 minutes per haul.
- 60% of observers were able to increase their sampling rate over time.
- 80 % now feel they spend about the same amount of time on deck as they did when they used paper and 20% feel they are spending more time.
- 1 Observer felt they had the same amount of rest and 1 much more rest.
- 80% Normally completed duties at home and felt they had more free time at home.
- Observers generally reported little to no increased sense of safety.
- Observers report positive effects on sampling procedures with good data entry flow, calculations automatically completed, helpful warnings and reminders to take specific data.

Improving Observer Programs through Incorporation of a Data Transfer Application on Tablet Computers

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Introduction

The Panama City Observer Program started working towards the creation and design of a mobile application to be used offshore for data collection in 2012. Electronic recording while in the field is a cost-effective solution to improving data processing methods. Directly entering data into a portable device allows for data validations at-sea; reduces data transfer time, both from field notebooks to paper data sheets, and data sheets to electronic databases; as well as decreases space needed to store collected information.

The most recent phase of the project, which began in 2015, completed the basic design of the application, with future plans for finalizing the product for bottom longline fishery observer coverage in the southeastern United States. This phase of application development attempted to correct issues with hardware, software and data connectivity that were apparent in the initial round of field testing. These include glare concerns, biological fluid and/or saltwater interference with screen use, poor GPS capabilities, resource heavy application components, and lengthy specimen data collection processes.

Methods

Observer coordinators worked with Elemental Methods, LLC to streamline the application and improve the user interface. Primary focus was placed on having information easily and quickly entered, while maintaining data integrity. The application was modified to include expanded data validation to remove input errors, photography capabilities for transferring images to the tablet wirelessly, and barcode scanning to advance sample processing methods. All office development and field testing was conducted using Samsung Galaxy Tab E (SAMSUNG-SM-T377A) tablets with Android 6.0.1.

Observers are now able to quickly access manuals and species identification guides straight from the tablet's home screen, allowing them to be readily accessible without slowing down the application. These documents can be updated regularly through remote access via Samsung KNOX (v. 2.6). The developed observer application further includes 256-Bit AES encryption for uploading data, which protects confidential information while also eliminating data loss or delay through mishandling through mail services.

Three sets of paired field testing were completed, with one observer collecting all data through the tablet app, and a second observer documenting the catch via waterproof paper. The tablet observer conducted coverage fully: identifying, documenting, measuring, and sampling the catch. They were instructed to say out loud their observations so that the second observer could document the information on paper in order to prevent data loss.

Results and Discussion

The initial two field tests showed problems that were not produced in office testing, some of which did cause data loss, however most of these were rectified for the third field test. Haul data was lost when the screen timed-out on the tablet, resulting in the data not being saved correctly. This concern was resolved by having the application automatically save data every three minutes to prevent such loss. Further, an adjustment to the previously entered trip identification number caused the complete loss of catch data taken to that point, as the application did not update data once adjusted. Steps are being taken to better link catch data to the identifying information, despite adjustments.

Overall, most complaints revolved around the time it took to document catch in comparison to the secondary observer. The tablet observer had to navigate through multiple screens to document each specimen, whereas the experienced secondary observer was able to simply write down a series of (memorized) codes, along with the measurement and sex information. While steps are continually being taken to reduce electronic documentation time, it is taken into account that this additional time on the vessel should be compared to the time needed at the dock/hotel and office for data transcription and entry. Adjustments for the future will include having fewer screens that the observer must navigate through in order to enter specimen information. Another option is to allow the observer to select which fields will be presented for each haul, as this can vary based on trip target (i.e. most elasmobranch weights are not taken at sea, whereas weights of teleosts are).

The tablet observer struggled to keep up with both sampling and documentation of the animals that were cut from the line for release, as they had to move across the deck of the vessel to look over the gunnel. However, this is a normal procedure while at sea, and may be better maneuvered with time and experience in handling the tablet. Having the additional observer aboard may have also hindered easy movement and observation. One avenue being explored is the addition of tablet holders (i.e. at the chest), along with tethers, that will allow secure movement with the tablet, reducing the need to leave the tablet in "safe", yet inconvenient, locations on deck.

Field testers also expressed concern over potential data loss with the lack of ability to write as many notes as needed, such as details of protected resource interactions or fishery violations, to be fully documented later. Options to circumvent this issue include voice recording during haul back, as well as having more capabilities with a digital notepad. Currently, only a single screen is available as a "scratchpad", which is not readily accessible at all times during the haul back. Additional concerns were over returning to previous specimens to document "late" observations, such as realizing upon butchering that the specimen is tagged. Easing the transition between specimens and increasing note-taking options are top priorities for the future.

A hardware issue was discovered when the tablet was dropped after the last haul, causing the screen to freeze. This wasn't reconcilable until the tablet battery died, after which the tablet was placed into a refrigerator to cool, and then charged prior to turning back on. This led to unease over losing the data that had been taken. Again, a better quality tablet that is anti-shock, along with a form of tablet tether will aid in minimizing this issue. We are also looking into Bluetooth USB drives to backup tablet data onto at the end of each haul. These separate devices would be kept apart from the tablets, ideally in a floating, waterproof case. The use of Bluetooth would aid in reducing the impacts of saltwater corrosion both on the tablet's and external drive's ports. If this route is taken, the program would develop a protocol for the backup data to be destroyed once the observer is debriefed, similar to the protocol currently used for paper data sheet copies.

Two issues addressed in this phase that have not fully been resolved are the GPS capabilities and issues with tablet glare. GPS recording has been improved with the current tablet, but wireless service is needed to test the full accuracy, which has not been pursued at this time. Tablet glare was able to be reduced using tablet settings, and therefore is limited to the equipment currently used. These will continue to be addressed with further development, both with the application and technological advances.

In the next phase of development, priority is to be placed on reducing the amount of time spent documenting a specimen by limiting the number of screens, customizing layouts, and simplifying the navigation between screens. The "scratchpad" will be available throughout the application for quick notes, containing multiple screens to more closely mimic a physical notebook. The GPS capabilities will be improved, through the tablet application itself or with proper satellite Wi-Fi service. Obtaining higher-quality tablets that are better designed for field use, including glare reduction, longer battery life, anti-shock, and water-resistance will also be a primary focus. Lastly, a simplified method of importing collected data into an existing Oracle 12c database is to be established.

The Panama City Observer Program is in the process of developing a third contract in order to achieve the enhancements described here. There were limitations present in the most recent contract that prevented development, as well as the drawbacks presented by the tablets approved for testing. With a better-defined list of contract expectations and recent technological advances, the next phase will complete the mobile application for the electronic recording of the observed bottom longline fisheries of the southeastern United States.

Abstracts of presentations that did not provide Extended Abstracts

Automated discard valves 2.0: the solution for weighing discarded quantities

Michiel Dammers, Pieke Molenaar

Wageningen Marine Research

Discard monitoring programs in Europe have been and are criticized by fishing industry and other stakeholders. This criticism is mainly focused on the estimated discard quantities that follow through a possible biased estimation of the total catch. Within the programs, it has occurred that the estimation of the total catch was lower than the sum of the landings and fish discards, indicating an inaccurate total catch estimate. The total catch estimate is currently essential within the discard monitoring programs as it is used as factor to raise sub-samples of fish catch or discards to haul level.

The Dutch beam trawl fleet operating in the North Sea have high quantities of catches per haul. These are processed in an efficient way through semi-automatic sorting and processing machinery on board of the fishing vessels. The beam trawl fishery is responsible for the biggest quantity of discards. For the biggest beam trawl vessels discard rates reach up to 74%. These rates are exceptionally high and in the 'danger zone' where small uncertainties in the catch estimation have a disproportionately large effect on raised discard quantities. We think it is essential that methods are developed to accurately measure total amount of discards to avoid uncertainties resulting from estimates. Therefore, the ‘discard valves’ are designed to fully automated weigh discard quantities falling through the shaft when the catch is processed.

During IFOMC08, the idea and first sketches of the discard valves were presented. In 2017 a prototype of the discard valve was manufactured and tested in laboratory and commercial environments. It opens and closes two separated programmed valves so that all fish, benthos and debris is measured in weight. This onboard solution improves data quality while observers on board can focus on their sampling.

Trends in Satellite Monitoring of Vessels at Sea

Paul Whitaker

KSAT - Kongsberg Satellite Services

Satellite imagery from both electro-optical and synthetic aperture radar (SAR) sensors have proven useful in many short-duration projects and vessel detection demonstrations over recent years. However, widespread adoption of satellite-derived information into MCS systems has been limited by available sensor coverage, data latency, and cost. The satellite industry is undergoing a revolution as smaller and cheaper sensors are launched with increasing frequency; each of these three long-standing barriers to satellite use in fisheries MCS are being addressed.

Sensor Coverage - No single polar-orbiting satellite is capable of providing daily coverage in mid- latitude regions, which has tended to frustrate MCS practitioners with large gaps in available information. Two trends are contributing to resolving this issue; dedicated multi-mission vendors capable of aggregating information from multiple satellite providers into “virtual constellations” and aggressive new satellite owners launching ambitious constellations – a step change in the availability of both electro-optical and SAR coverage. Some SAR missions being launched in 2018 promise average revisit times of less than three hours.

Data Latency - Data latency is another issue commonly limiting the utility of satellite-derived information in MCS – information must often be fresh to be of value. As satellites continue to grow smaller in

size the associated ground station requirements are also reduced; smaller satellites can use smaller antennas. This has led to a proliferation of antennas and ever-larger ground station networks with reduced data latency. It is currently possible to deliver near real time information in less than two hours anywhere in the world – in some areas satellite service providers are paying penalties when their information is more than 30 minutes old.

Cost - Satellite-derived information has been perceived as expensive by many in the fisheries sector. Two trends are beginning to make it more affordable; new government-owned constellations and competition among private-sector companies. In addition to the ESA missions launched in the past several years additional government-owned constellations are being launched in the next two years with specific capabilities for vessel detection; combining SAR and AIS on the same platform with relatively high resolution. As innovative private-sector companies launch new missions they are also launching new business models – forcing the legacy providers to reconsider their restrictive and expensive policies on licensing and data use and driving prices down.

This presentation will quickly touch on these three key trends bringing satellite-derived information into more widespread use in the fisheries sector.

The 'catch-cam', a portable, low budget, easy to build electronic monitoring system

A.T.M. van Helmond, D. Benden, D. Burggraaf

Wageningen Marine Research

To improve sampling on board commercial fishing vessels Wageningen Marine Research developed the "catch-cam" system, a simple portable easy to build low budget electronic monitoring system.

With the implementation of the European Landing Obligation scientific sampling methodologies on board commercial fishing vessels will have to change. A switch from discard to a catch sampling strategy implies an increase in sampling size, i.e. discards being, a smaller fraction

of the total catch. Collecting larger samples on board is challenging: A higher workload, more time or more human resources are needed, and there is an increasing level of interference with the crew. In addition, due to technical modifications on-board the vessels, e.g. renewed

catch sorting devices, closed hopper systems and fast running conveyor belts, it is increasingly difficult and dangerous to collect unsorted catch samples. Video recording the catch during transport over the conveyor belt during the sorting process provides a complete coverage

of the catch. Taking or selecting pictures results in a (random) 'snap-shot' or 'virtual sample' of the catch, 50 – 100 snap shots per haul will provide an accurate estimate of the catch composition. Compared to the current protocol, where observers sample only one or two baskets of fish per haul, digital snap shots provide a higher sampling density, and therefore, a more representative sample of the catch. In addition, the risks of taking digital pictures with a camera that can be controlled by a laptop or smartphone from a distance will be considerably less, than taking a physical catch samples form a fast running conveyor belt.

Current REM systems are expensive (between 9.000 and 10.000 €) and costume made for a particular vessel. As a consequence a REM system is not easily transferred between vessels. The aim is to develop a low budget portable electronic monitoring system that observers can bring on board to improve catch recording on all vessel types. For this purpose Wageningen Marine Research developed a prototype. The system consist of a digital camera which is controlled by a single-board computer system (Raspberry Pi), which can be both in any (online) electronic store, a waterproof housing is made of a pvc pipe, available in any hard ware store. A Graphical User Interface (GUI) is developed to control the system from a regular laptop.

Observer Benefits of Advanced Technology in the Northeast Fishery Observer Program

Ryan Flannery

Northeast Fisheries Observer Program/East West Technical Services

The Northeast Fisheries Observer Program has recently acquired several innovative advancements in field sampling technology. These advancements have positively impacted the operational tasks of both the end user and the observer. I would like to present my personal experience of working in the program during this technological transition. The new field sampling tools that I will concentrate on will include the Samsung Galaxy Tablet, the M1100 Scale by Marel, and the DeLorme InReach Explorer Satellite Communicator.

When I first started observing in 2014 we did not have any of the tools listed above. In respect to collecting data all I had were two spring scales, my notebooks, and my data logs. In the field, data would be collected by using a write in rain notebook where it would then be transcribed to data logs. I would then have to wait until I could gain internet access to transfer and upload my data to Northeast Fisheries Science Center's database.

Reading the spring scales were a bit of a challenge due to the circumstances of the work environment. This would cause room for error when calibrating a tare weight and obtaining actual weights. With the addition of the Marel M1100 Scale, calibration comes as easily as the touch of a button, and the measured weight is displayed digitally, minimizing any reading errors. Furthermore, baskets, totes, etc. can now simply be placed on the scale plate to get a reading, rather than being hung from a spring. With the addition of the Samsung Galaxy tablet the collected data can now be digitized in field via the NEFSC OASIS application. This

application organizes the data efficiently, which can then be uploaded at the touch of a button once internet connection becomes available. The addition of the tablet has eliminated waiting periods of several hours to a day for new trip data to reach end users, and saves countless hours of personal time for observers. Another great advancement has been the InReach.

This device allows for satellite communication with my data editor or provider, in case further assistance is needed. This form of in field communication was nearly impossible in the past.

Because of these tools the data is more accurate, the workload has lessened, and the communication has greatly improved. This presentation can open discussion on future technologies that can be used for data collection. There have been talks of paperless data logs, voice

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Flatfish in the spotlight, learning from fish behaviour

Pieke Molenaar, Michiel Dammers

Wageningen Marine Research, IJmuiden, Netherlands

With the introduction of the European landing obligation fisherman and scientists have been working on selective solutions for fisheries with substantial discard quantities.

Especially in demersal beam trawl fisheries targeting flatfish, gear innovation has not been sufficient to meet the current landing obligation. Despite effort from fishing industry and scientists, effective selective devices have not been found. The development of those devices are frequently based on trial and error, as knowledge on fish behavior is limited. This knowledge can accelerate the development and possibilities for selective trawls. However, video recordings of fish behavior inside demersal trawls are frequently impossible due to low light conditions and dust clouds, originating form suspended sediment by trawl footrope.

Within this project 'flatfish in the spotlight', we developed a method to monitor flatfish behavior in beam trawl fisheries. For useful recordings of flatfish behavior, trawl modifications were applied to lift the exterior part of the trawl to minimize suspended sediment. Those modifications combined with compact recording system and a powerful light, observers

can provide fisheries and scientist with useful recordings to enhance the development of selective trawls. Observers in several other fisheries can apply this concept, to obtain a better understanding of fish behavior and fishing technology.

Android application for the collection of observer data in the NAFO Regulatory Area

Jana Aker, DJ Laycock

Northwest Atlantic Fisheries Organization, Canada

The current data collection mechanism for observer data in the NAFO Regulatory Area is not ideal for observers to enter data, and also not ideal for the further analyses of the NAFO Observer data by the NAFO Secretariat. As part of the restructuring of the NAFO Observer program, the NAFO Secretariat has been developing an application for Android devices that could function as a data storage and entry mechanism for Observers operating at sea. The application has been designed to follow the existing data reporting structure outlined in the NAFO Conservation and Enforcement measures for collection requirements by observers. It has been developed with the harsh conditions at sea in mind and include large buttons, automatic data entry for certain fields (e.g. time, date, latitude, longitude), the ability to store data until a Wi-Fi or satellite connection becomes available, etc. A multi-media tutorial has been added to some screens in the app to guide/aid the user of how to use the app. The application is currently still in the development phase, so many customizations may be made as the application is tested.

Session 10. Operationalizing technology-based monitoring: Learning from programs around the world

Leader: Howard McElderry

Electronic Monitoring (EM) technology has been around for over a decade and many agencies responsible for fishery monitoring are eager to learn from the experiences of those who have fully operational EM programs. Issues such as program objectives, equipment choices, deployment and maintenance of gear, video/photographic examination, data accuracies and inaccuracies, funding models, etc. were examined in an attempt to identify "best-practices" in establishing these programs.

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Oral Presentations - Extended Abstracts

Electronic Monitoring in the Hawaii Longline Fisheries: Year One Progress

Matthew J. Carnes

Joint Institute for Marine and Atmospheric Research, Hawaii

In Hawaii, regulations require that 100% of the shallow-set and 20% of deep-set longline fishing trips have an observer onboard the vessel. The role of the observer in this fishery is to document interactions with all protected species, identify and enumerate fish catches and bycatch, and collect various requested samples for life history studies. The Pacific Islands Regional Implementation Plan for Electronic Technologies was developed in 2015. In early 2017, Pacific Islands Fisheries Science Center (PIFSC) and the Pacific Islands Regional Office (PIRO), in collaboration with the fishing and electronic monitoring (EM) industries, began a project to gather data on the efficacy of electronic technologies in fishery-dependent data collection to collect timely, cost-efficient data needed to manage US federal fisheries. These data will lay the groundwork for the adoption and operationalization of EM in the Pacific. To date, EM systems are on 17 vessels that operate in both deep-set and shallow-set fisheries. The operational aspects of these fisheries make capturing and reviewing EM data a fairly simple process. Fish are large and easily distinguishable. They are caught at a low enough frequency that accurate review is still possible at four to 16 times playback speed, allowing trips to be processed and reviewed in about five days. Most fish are landed at a single port in Honolulu, making data recovery and system maintenance manageable and affordable. Year one of the project, which included installing and refining the EM systems, has begun to show promising results for monitoring catch, bycatch, and protected species interactions.

PIFSC's goals for this project include accurately extracting catch and protected species interaction data from the video captured by the EM systems. Together, the Joint Institute for Marine and Atmospheric Research (JIMAR) video reviewer and the Saltwater Inc. EM technicians have refined the system configurations and review protocols to produce high quality data. Over the course of ten months, staff reviewed more than 1800 hours of fishing activity. EM data were then compared to at-sea observer data from concurrent trips to determine the effectiveness of the EM systems. For these data comparisons, selected trips are watched in their entirety to mirror the data format in use by at-sea observers. The review effort has been largely carried out at an eight times playback speed, whereby it is possible to watch an average haul of about 12 hours in just two hours. The reviewer limited playback to six hours per day at the maximum, with breaks from review throughout the day to carry out quality assurance procedures on the data. This daily work flow allowed the reviewer to maximize data quality while avoiding review fatigue. By holding the reviewer to a standard of hauls reviewed per week rather than hours or trips, managers can anticipate how many reviewers would be needed to watch the intended amount of data to satisfy coverage needs, while allowing the reviewer to establish his or her own workflow which is key in preserving both data quality and mental health.

As the figures demonstrate, this early iteration of EM is proving successful as a tool for estimating catches for retained species, as well as estimating discards for economically valuable species. The Hawaii-permitted shallow-set longline fishery interacts frequently with sharks. Pulling sharks close enough to the vessel to be identified poses a safety concern for crews. Shark teeth are capable of cutting the fishing leader between the hook and the mandatory weight designed to mitigate bird interactions. When the line is broken while under tension, the weight can become a dangerous projectile that is flung towards the crew. To reduce the risk to the crew, lines that have caught a shark are cut immediately to release the animal before tension can build up. This safety measure is reflected in the low percentage of verified sharks in the reviewed video footage. If no animal is seen, even if the crew actions are consistent with a shark catch, reviewers do not assume a species identity and instead classify the event as 'unidentified catch event'.

	Observer	EM	Piece Difference	Percent Difference
Tunas	3688	3690	+2	+0.05%
Billfishes	521	517	-4	-0.8%
Sharks*	1534	685	-849	-55.3%
Protected Species	13	12	-1	-7.6%
All Species	13349	11888	-1461	-10.9%

Table 1: Retained and discarded catches for 165 longline hauls. *see above for shark explanation.

A data gap regarding non-landed bycatch was identified by evaluating the video footage. The reviewer was able to identify systems that were producing low detection numbers of bycatch and discards. Reconfiguring systems to minimize these data gaps included repositioning of the cameras and altering the camera angles. Preliminary data from 2018 show that by mirroring system configurations on vessels that produce higher catch detection rates, systems with lower detection rates can be reconfigured, minimizing those data gaps. This first iteration of system deployments demonstrated that retained species can be easily detected and identified regardless of configuration. Using a randomization test, there was no statistical difference for any retained species except for yellowfin tuna between the compared EM and at-sea observer data sets. The next figure separates out retained species from total catches.

	Observer	EM	Piece Difference	Percent Difference
Tunas	3266	3290	+24	+0.7%
Billfishes	413	428	+15	+3.6%
Sharks	3	3	0	0.0%
All Species	5847	5874	+27	+0.5%

Table 2: Retained catches for 165 longline hauls.

The first year of the project has demonstrated that EM can be a valuable tool for fisheries-dependent data collection in pelagic longline fisheries. Testing of the EM system will continue into a second year with continued refinement of protocols and system configurations to optimize camera placement, image quality, and system reliability.

Five years of electronic monitoring onboard tropical tuna purse seiners

John Ruiz

AZTI Tecnalia, Spain

Full observation coverage in some tropical tuna purse seine fleets has been adopted on a voluntary basis partially as a result of an ISSF (International Seafood Sustainability Foundation) Conservation Measure, which requires ISSF Participating Companies to "conduct transactions only with those large-scale purse seine vessels that have 100% observer coverage (human or electronic if proven to be effective)". In addition, there is a Code of Good Practices that Spanish tuna purse seine owners have agreed to follow on a voluntary basis, which also requires 100% observer coverage. It should be noted that 100% human observer coverage is required for large-scale purse seine vessels operating in the Pacific Ocean, both in the IATTC and WCPFC Convention Areas. However, this requirement does not exist in the Atlantic (ICCAT) or Indian (IOTC) Oceans, so the reasons for employing 100% observation coverage vary among regions.

In this context where tuna fleets were looking for full coverage, electronic monitoring (EM) is seen as an opportunity. It is an emerging field which has been developing rapidly during the last decade, with high potential in fisheries monitoring and, hence, in fisheries science and management. The tropical tuna purse-seine fishery joined these initiatives to incorporate EM systems for monitoring purposes in 2012, when a first pilot study was conducted with the aim of validating the efficiency of this technology, comparing it to human observers' data. Since then several pilot studies, involving at least four different EMS brands, have been carried out. These trials showed that both human observers and EM are complementary, and each has their own weaknesses and strengths. Although EM is still limited in some tasks compared to observers, it provides a valuable tool to increase monitoring coverage on purse seiners, and it is specifically adequate to: (a) verify positions of the vessel, (b) estimate number of sets (stratified by type), (c) estimate total target tuna catches (including retained and discarded fractions), (d) estimate bycatches and (e) monitor activities with FADs (fish aggregating devices).

In view of these findings, pilot studies have given way to the implementation of several EM programs. Currently there are several purse seine fleets that have voluntary EM programs in progress in the Atlantic and Indian Oceans (EU Spain, EU France, Seychelles). However, data collected by EM would only be useful if it is collected in a consistent and harmonized way, so before implementing these programs, it was necessary to develop minimum standards for the use of EM systems onboard tropical tuna purse seiners.

These minimum standards are divided in three sections as follows:
1) Before the trip (Installation, certification, audits)

- *Customized to vessel level*: There is not a standard EM configuration that will fit all vessels in a fleet, thus each installation must be customized for each vessel
- *Tested (and certified) by a third party*: All manufactures should be equally valid, but all systems should be tested through pilot studies before being implemented

2) During the trip (Data collection)

- *Robust System*: Capable to resist rough conditions at-sea
- *Secure System*: Tamper proof system with encrypted data, near-real-time remote online "health statements" and GPS linked imagery.
- *Cameras*: Digital cameras covering all areas of interest according to the vessel and fishing manoeuvres. Frame rate and image quality must assure the detection of both catch and bycatch species.
- *Independence*: The system needs to be self-sufficient with the exception of minimal maintenance by crew.

- *Data storage and autonomy*: The system should have enough autonomy to cover a minimum of 4 months of fishing.

3) After the trip (Data traceability and analysis)

- *Dedicated image analysis software*: Systems should provide integrated software to facilitate the review of images.
- *EMS data analysis and reporting*: Data analysis and reporting should be done by institutions, organizations and independent bodies experienced in work with on-board observers.
- *Office observers" training*: "Dry" observers must have specific qualifications and skills.
- Compatible with ongoing standardized data flow and databases: Compatible data output format.
- *Hard drive chain of custody*: The system must assure traceability of every hard drive and information recorded on-board.

In conclusion, both human observers and EM systems are complementary, having their own weaknesses and strengths. In general terms EM has the advantage of tamper-proof information and the possibility to review images as many times as desired. This streaming is especially interesting when events related to the fishing operation occur in various areas of the vessel at the same time, to monitor 24/7, or in cases when monitoring has compliance purposes only. In addition, work is underway for development of tools allowing EM data to be analyzed automatically, reducing costs and time of data analysis and providing a more standardized output. Finally, from an economic perspective, in the purse seine fishery, because non-monitored searching activity fills most of the time, EM cost savings compared to full-time observer programs are significant. Nevertheless, EM would still be limited in a purely scientific monitoring program to coverall observers' tasks and should rather be considered as a complementary tool for human observers

This paper summarizes the steps and milestones of EM from the first pilot studies until the current implementation of this technology in commercial fishing trips.

Open Discussion Session

Q -Noted that in 2021, the US market will be closed to imports of marine products from countries who's fisheries capture marine mammals and do not comply with standards laid out in the MMPA which specify detailed bycatch information among other things. Do you think that EM will be approved as a tool to monitor marine mammal bycatch and also demonstrate fisheries that are marine mammal free? Some of their fleets are not suitable to host observers and therefore will benefit with EM.
A - All marine mammal data collected through EM is accepted in the ICES database, in the same manner as observer data. All countries report their DCF data but Denmark is the only one using REM as the source data. Feels that REM is just as good as observer data for this purpose, and more valued than DCF source.

A - US fisheries also use EM to track for incidence of marine mammal bycatch They are planning to use EM in the drift gillnet fishery on West Coast US for this specific purpose. Feels that EM will be accepted globally as a proven tool for this purpose but will be dependent upon the standard in how this is laid out.

Q - Two questions: for Kind-Larsen, how many porpoises were satellite tagged and have their been any findings of use for fisheries management? For van Helmond, for studies beyond the Netherlands, what were the incentives used to encourage vessels to accept EM?
A - Satellite data based on 67 porpoises and pooled with survey data shows the same hot spots for occurrence, which are stable over time. This supports risk-based management approaches that specify mitigation measures for fleets operating in different areas and seasons. Information also supports dialog with fishermen on development of management measures.
A - In most European studies, the incentive used for vessels to take EM was extra quota, under the condition that all catch applied against the quota. Other incentives included exemptions from technical regulations (e.g., gillnet mesh size in Denmark).

Q - Commented that the larger question for many fisheries will be of consideration toward overall scale – this isn't a question of how to make EM work on a vessel, but more one of how to make an EM program work for a fleet.
A - Scale and expansion will be critical, but one cannot understate the importance of being very clear on the goals and objectives up front. Goals and objectives, as well as core data elements drive the decisions on what kinds of tools are needed. EM may not be the best solution in all cases.
A - In the EU is there is a landing obligation being driven as a top down initiative which is driving a big change. Cooperation and incentives from industry are essential to make EM work effectively.
A - While EM may have broad application, it is important to keep in mind the very large scale of small boat fisheries. The overall numbers of vessels in these fisheries presents a huge scaling challenge such that EM may not be useful to meet the data needs.

Q - The use of AI (automation of data processing) may negatively impact the current EM business models where data processing services are integral to current EM programs.
A - Commented that EM video review may not be a useful way to spend time and program resources.
A - Image review is a program function that can be outsourced so may not be intrinsic to EM provider role. The goal is to achieve good comprehensive monitoring and need to question if scientists staring at video is the best investment of their time.
A - Disagrees with outsourcing video review because the program benefits from having scientist doing to review, gaining larger perspective and helping to address new questions. This comes from the analysis by people that are interested in marine data.
A - Commented that the EM business model is not defined and various providers are providing EM services from a range of perspectives and competencies. The role of automated image processing, versus outsourced image processing, or that done in house will vary by program and service provider.

Q - General question about the types of sensors used and where installed.

A - There are different systems and sensor types in use. In tuna seiners, vessel speed is very useful to differentiate activity (< 4 knot = fishing while > 4knt = sailing).

Q - Comment that the EM field is rapidly developing and noted that many practitioners tend to be narrowly focused toward their own regions, fisheries, issues, etc. How can we as practitioners share knowledge and ideas to quicken the pace in scaling up. Mentioned the EM Info website as source for sharing knowledge (www.eminformation.com).
A - Comment re previous question that idea sharing is important and there are several EM specific meetings. Question to Ruiz regarding the "yellow" information – the information that might be of use (versus red, not reliable information) as always interested in new potential areas of information.
A - 'Yellow' refers to situations like too many fish on the conveyor belt where species composition is not possible, or species that are not easily distinguished from camera images.
A - Comment that conference discussion has tended to be binary, relating to EM or observers while there is a whole universe of technology such as handheld DNA samplers, hydrophones, drones, etc. that is available but not being utilized.
A - Commented that the focus toward elaborate EM systems on big boats tends to overlook the fact that 60% of the world catch comes from small vessels. Referenced the Indonesia presentation where fleets of 100,000's of very small vessels will require simple camera systems.
A - Commented that the technology for these applications can be quite simple and low cost.

Q – Commented that while some data processing can be automated, there is value in working with it directly to gain a 'feeling' for what is being observed.
A – Automation may better serve scale and also share segments to achieve personal review.

Q – Different countries have different interests, different capabilities. Suggests that a standards-based approach is needed to provide uniformity across a region where there are different countries, capabilities, interests, etc.
A - Commenting on the remark made that 'top down doesn't work for EM'. Recent attention on discard policies is one of the reasons why EM is needed. In order to successfully implement landing obligations, high levels of at sea monitoring will be required, and this could only be applied with a top down approach. Behavioral changes are difficult, especially if changes are not compulsory. EM is probably the best solution and will have to work in a top down setting.

Poster Presentations – Extended Abstracts

Further development of video electronic monitoring system to estimate protected species bycatch in shrimp trawl fisheries

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NOAA Fisheries began placing at-sea observers on commercial shrimping vessels in 1992 in the US southeastern region to identify and minimize the impacts of shrimp trawling on federally managed species. Analysis of bycatch data relative to smalltooth sawfish, *Pristis pectinata*, a federally-listed endangered species, indicated the level of take was higher than mandated. In light of the costs associated with observer coverage and given the rare event of capturing a smalltooth sawfish, increasing observer coverage to refine the take estimates of this species may not be practical. We explored the use of electronic monitoring (EM) to provide a valid alternative to increased observer coverage. A pilot project on contracted commercial shrimp trawl vessels found the system performed well in capturing video of the overall fishing operations. The hardware held up for the duration of the trips with no water ingress to the deck components, and there were was only one significant gap that may have been caused by a system component malfunction. The EM systems performed well in capturing video for a total of 15 trips, consisting of 391 hauls over 203 days at sea. Of the 15 trips captured by the EM system, 7 were also observed trips with a certified fishery observer on the vessel. Overall camera framing of the hauling activity for the project was well placed and documented all major areas of the vessel in which there was fishing activity. The reviewer was able to see the nets as they were brought alongside the vessel, as they came out of the water, and as they were brought onto the deck where they were emptied and sorted. Species identification for larger animals was possible. Even during periods of low light, the EM reviewer was able to detect and identify larger catch items such as sharks and rays (Figure 1). Although no smalltooth sawfish were observed, the catch and safe release of a loggerhead sea turtle, *Caretta caretta,* which had been caught in the trynet was fully captured by the EM system. Catch composition documented by the EM reviewer was compared for the observed trips. For the compared trips, 23 hauls contained 29 bycatch items (teleosts and elasmobranchs) in the observer sample that met the criteria of being over 1 kg. Of these catch items, 27 of the 29 were also detected by the EM reviewer, leading us to conclude that EM would be an effective tool for detecting protected species interactions in the Gulf of Mexico Shrimp Trawl fishery (Figure 2).

Figure 1. Sharks and rays documented with the EM system.

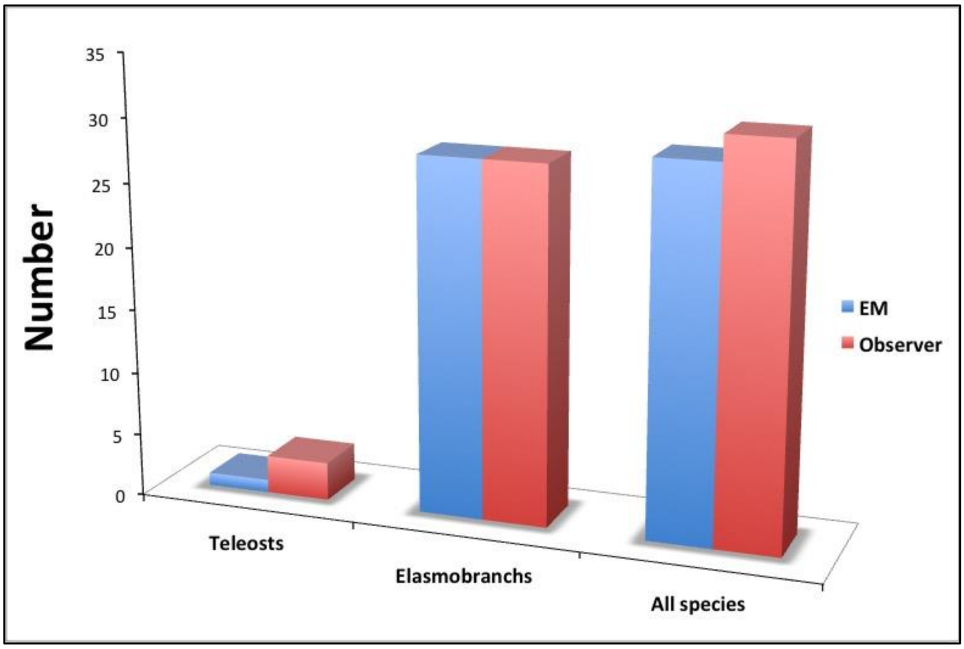

Figure 2. A comparison of the overall catch documented by the onboard observer and the EM system

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A comparison of data collection from observers and CCTV system in the Scottish Demersal Fleet

James Dooley, Helen Holah ,Neil Campbell

Marine Scotland Science (UK)

<u>Acknowlegements</u>

This study was funded by the Scottish Government under Project SU03A0: Advice – REM and Catch Quota Development

Abstract

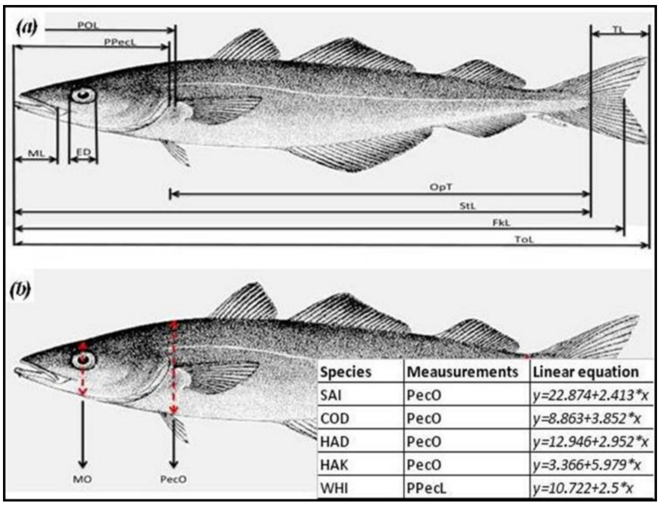
Data collection at sea is a core part of the fishery observer's role. Increasingly, the deployment of electronic monitoring technology (CCTV systems, gear sensors, etc.) data is used to supplement the volume of information available to manage.

Introduction

The Scottish scientific observer programme is nearly in its 30th year. Operated from the Marine Laboratory in Aberdeen (now part of Marine Scotland Science) with the addition of the private stakeholder the Scottish Fisherman's Federation (SSF) it has collected discard and landings data from demersal species and crustacean species from various types of trawl fishing boats around the Scotland. (Fernandes et al., 2008) Processes in the monitoring of fishing vessels have improved over the last decade. In 2008 "remote electronic monitoring" (REM) was trialled on-board certain Scottish fishing vessels as a compliance project. By 2011 REM was in use on board 25 vessels. This provided an opportunity to increase Marine Scotland Science's sampling potential. To build confidence in novel image analysis it had to compared against the traditional on-board sampling techniques.

Methods

This opportunity came up as a fully trained observer completed a trip in 2014 where the vessel was set up with REM equipment. The observer collected length frequencies and estimated discard bulk visually and raised data accordingly. Calibrations of the REM equipment were performed by measuring the conveyor belt and discard chute on installing the cameras. This allowed for measuring of fish remotely using the novel tool. Three of the hauls were sampled using REM Archipelago^{tm} programme by three fully trained REM analysts. The more occluded fish on the belt had to be measured using allometric lengths that had been collected from a previous study (Butler *et al.,* 2013) The preferred methods were selected on their comparative accuracy against the total length of the fish in the previous trial. **Pectoral Operculum** (PecO) for *Pollachius virens, Gadus morhua, Melanogrammus aeglefinus,* and *Merluccius merluccius* and **Pre Pectoral Length** (PPecL) for *Merlangius merlangus*



Species	Meausurements	Linear equation
SAI	PecO	*y=22.874+2.413*x*
COD	PecO	*y=8.863+3.852*x*
HAD	PecO	*y=12.946+2.952*x*
HAK	PecO	*y=3.366+5.979*x*
WHI	PPecL	*y=10.722+2.5*x*

Fig 1, a-b. –shows preferred methods of measurement used for occluded fish on the belt by species

On the REM the entire haul was measured length frequencies occluded and semi occluded fish were measured using the preferred method for the species. This measurement was then multiplied up using the linear equation and the estimated length was then rounded down to the nearest cm the biomass was then calculated for both the on-board observer and the 3 REM observer using the length frequencies and the Marine Scotland Science length weight distribution calculator .

Results

The comparison between all the observations of ranges of fish and length frequencies is quite similar (fig 2 a-g) The weight of sampled in haul 3 looks a lot closer among the 4 observations there is also one missing observation from the on board observer.

Implementation of electronic monitoring on verification of good practices agreement compliance

Itzia Canive, Oihane Erdaide, Asier Olalde, Gonzalo Legorburu

Digital Observer Services, Spain

The Code of Good Practices (CGP) is an agreement between ANABAC and OPAGAC which contemplates several measurements such as bycatch liberation methods or the use of non-entangled FADs to reduce to a minimum the interaction with sensitive species like sea-turtles, sharks and rays. This agreement has the aim to conduct a more sustainable and responsible fishing adopting those measurements onboard. In this context Digital Observer Services (DOS), an independent fisheries consultancy and Electronic Monitoring (EM) service provider, is responsible of CGP compliance related data collection using SeaTube system. For the past three years, DOS has implemented suitable EM protocols for data collection and verification of CGP agreement.

The requirements of CGP agreement establishes the onboard equipment design and configuration. The recording system is continued, 24x7 during 365 days of the year, and all the possible technical issues that could occur are registered at real time being assisted remotely by the maintenance service at DOS. Hard drive discs (HDD) used have capacity enough to store securely complete fishing trips and are transported in suitable suitcases. The traceability of the HDDs is also monitored along the transportation. The standardized analysis protocol and later debriefing may vary depending on the project requirements and finally the report is prepared to send to external advisors.

This methodology asses compliance to directives and agreements in a time efficient way allowing a vast fleet coverage.

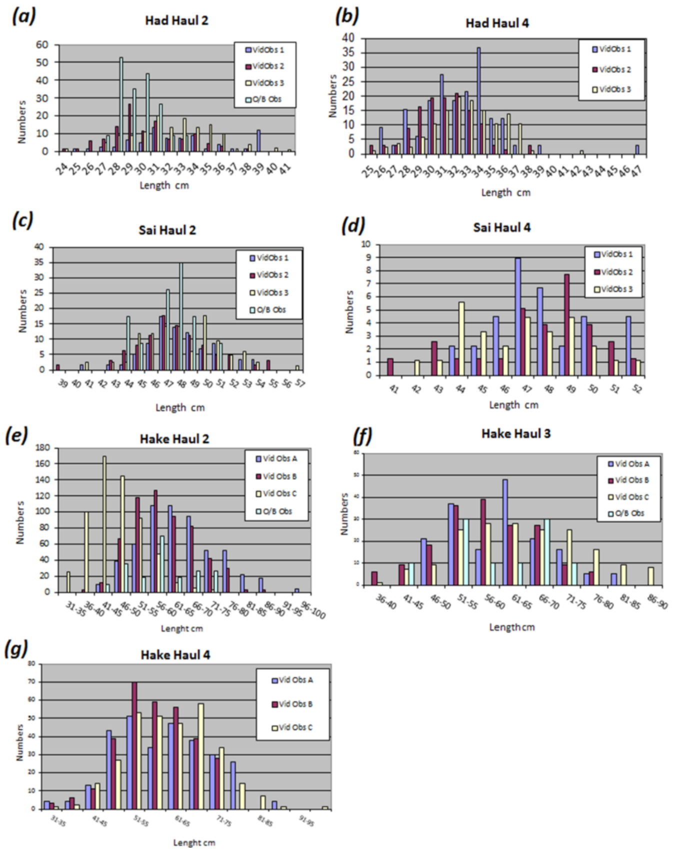


Fig 2, a-g. -shows length frequencies of 4 observations of the same haul by REM and On-board Observing (Vid Obs 1-3) and On-board Observing (O/B Obs)

BIOMASS	HAUL 1	HAUL 2	HAUL 3	HAUL 4
Vid Obs 1	FTP	1338.9Kg	315.7Kg	628.5Kg
Vid Obs 2	FTP	1141.2Kg	291.1Kg	563.8Kg
Vid Obs 3	FTP	654Kg	412Kg	835.4Kg
O/B Obs	FTP	503.3Kg	293.7Kg	NOT OBS

Fig 3-shows Total Biomass of Each observers estimates of each haul **FTP** indicates partner vessel took fish. NOT OBS indicated a non observed haul

Discussion

The study has shown that ranges of fish are quite close to each other between the on-board observer and the REM observer. This is promising and means that with a bit more work and a few more studies like this one could lead to better and closer comparisons. A larger sample maybe needed from the on boards sampler as in both occasions either one or two baskets were used as the sample. This is not enough as the fish in these hauls were large and doesn't give an accurate enough account of the discarded fish.

What could account for the differences in weights in haul 2 and 4 (fig 3) could be small differences in the allometric measurement which could have led to an extrapolation in the total length of fish thus giving a different weight to individual fish. The Allometric data needs a bit more work there is need to ground truth this farther by the collection more samples to add to the accuracy of the model. In a further comparison study maybe using two allometric lengths to get an average estimated length. One other aspect is that in one of the hauls the on-board observer was sea sick and therefore didn't sample on haul this shows one of the advantages of REM sampling. A larger trial on a research vessel could also add to the robustness of CCTV data collection.

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Butler, N. 2013. Developing allometry to estimate the length frequency distribution of partially occluded fish via Remote Electronic Monitoring. MSc Thesis, University of Aberdeen

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Comparing electronic monitoring system with observer data for estimating non target catch and discards on French tropical tuna purse seine vessels

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Observer data are essential for the management of long term sustainable fisheries as it provides important information on fish stocks and the impacts of fishing pressure on the marine environment. Observer programs for tuna fisheries have been implemented for many years to help monitoring fishing operations worldwide and to control what is known as best practices. Each program involves industry and science collaboration and aims to collect a range of data to improve the assessment of tuna stocks, bycatch discards and compliance to Regional Fisheries Management Organization (RFMO) conservation measures.

Since the implementation of observer programs, most of these data were collected by human observers on board but in recent years, electronic monitoring system (EMS) on tuna fishing fleet has been tested as an alternative observing tool to complement and increase observer coverage. EMS consists in image recording systems with hardware (cameras, sensor and GPS) and software to monitor and post-analyze the fishing activities of a vessel. One advantage of the EMS is to increase the monitoring on vessels where human observers are not be able to work for logistic and security reasons. Another advantage is to compensate for the potential high costs and complex organization involved in observer placement and debriefing. In general, tuna fishing companies found in this new technology a good opportunity to increase to 100 % the observer coverage of their fleets with the objective to obtain an "eco-label" certification.

Pilot studies on EMS have been conducted on purse seine tuna fisheries both in the Indian and Atlantic Oceans where data requirements for management purposes of tuna RFMO are increasing. Advantages and drawbacks of EMS have been compared to the classical on-board observation. Preliminary results indicated that EMS can be more effective for some specific tasks, equivalent for some of them, and weaker for some other tasks currently conducted by humans. After some adjustments, it can be a valid tool to monitor the fishing effort, set type, total tuna catch by set, and bycatch. As a consequence, a large number of tropical purse seiners are now equipped with EMS. However as boat configuration and manufacturer installations are different, minimum standards are recommended for EMS and each vessel needs to be first certified by these minimum standards.

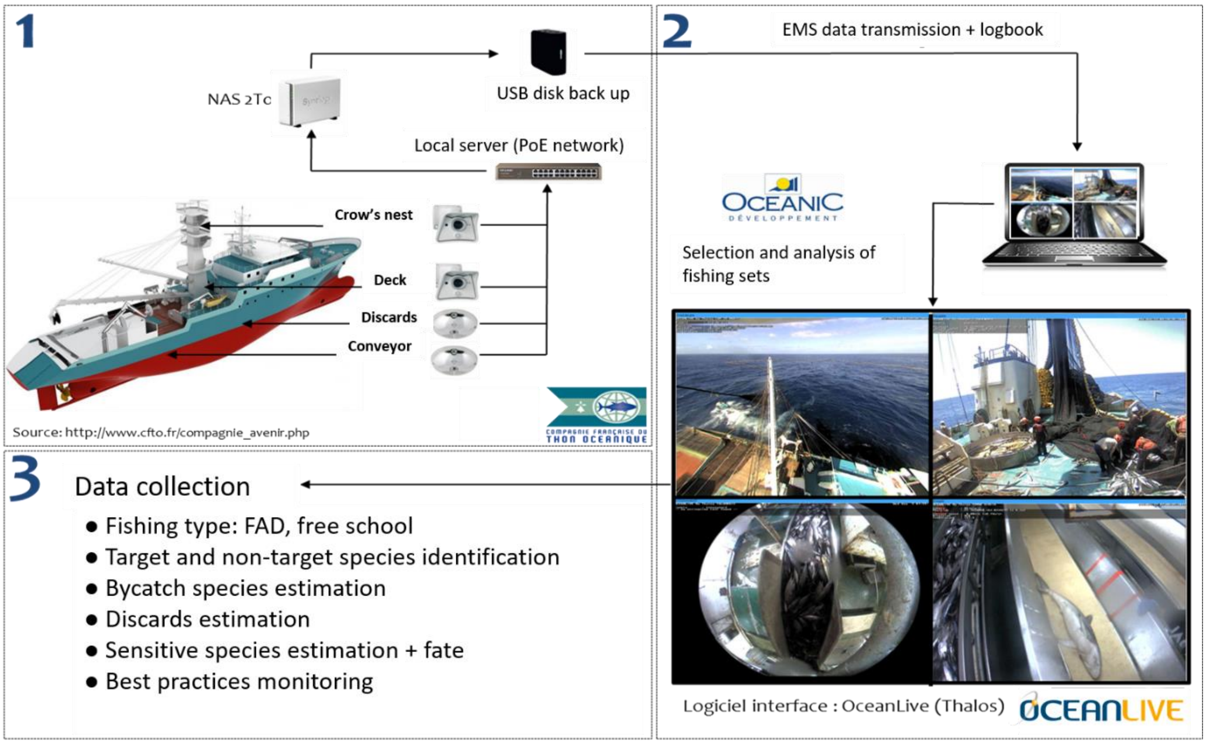

Figure 1. Schematic representation of the EMS installation and the process of data collection

In this perspective, an electronic monitoring project (CAT OOE) was launched and implemented in 2014 by Orthongel within the OCUP (*Observateur Commun Unique et Permanent* - Common Unique Permanent Observer) program on French tropical purse seiners. The OCUP program aims at taking scientific observers on-board tropical tuna purse seiner to cover 100 % of their activities both in the Indian and Atlantic Oceans. The general objective of the CAT OOE project was to test the EMS installation on French purse seiners and to validate the quality of electronic data compared to on-board observer data. As most French vessel configurations include a discard belt, a particular focus was established on tuna and non-target species discards estimation.

In this study, 'mixed' trips involving both EMS and on-board observers were conducted on two purse seine of CFTO fishing company operating in the Indian and Atlantic oceans over 2015-2016. EMS data were stored digitally and full hard disks are transmitted to Oceanic Développement for analysis. Electronic recordings were reviewed using the *Oceanlive* software developed by Thalos. Data on discards and bycatch from common to rare sensitive species were collected (Figure 1). Non-target species and discard data from both observations were compared using generalized linear models. Good matches between methods were obtained for tuna discards (Figure 2). However divergences were noted for non-target catch. Globally, EMS seems to systematically overestimate the number of individuals compared to observers. However this trend depends on the species. For species with high occurrence which are systematically discarded, EMS provided higher estimates as on-board observation. However, for sharks and high commercial value species, EMS systematically underestimated occurrence and discards volume compared to observers. Indeed these species can be handled at different places on board and EMS usually failed to document their release or retrieval due to camera distance or dead angles.

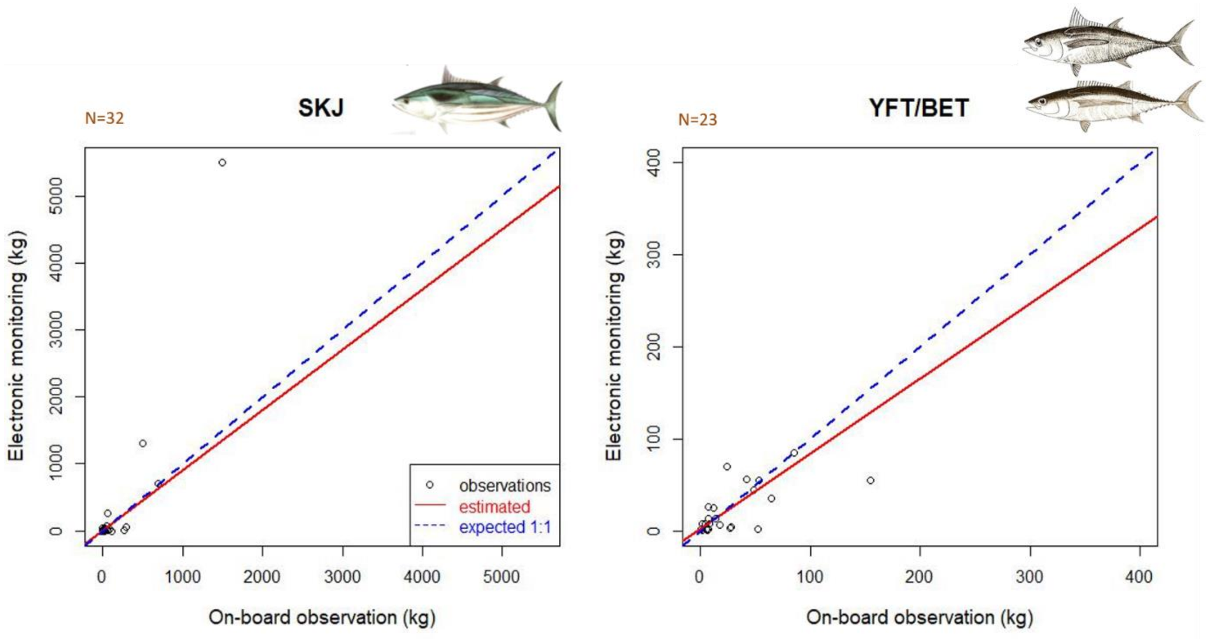

Figure 2. GLM estimated regression (solid line) and expected 1:1 relationship (dashed line) between EMS and on-board observers records of tuna discards. GLM analysis was performed for skipjack (N=32) and yellowfin/bigeye (N=23) tuna discards.

We conclude that EMS installed on French purse seiner is able to provide accurate data on tuna discards and non-target catch at an acceptable species identification level and validates many of similar observations delivered by human observers. In some cases EMS could actually be more efficient than observers to describe the discarded volume of non-target species as it allows exhaustive counts on the discard belt. With some improvement on camera installation as well as with minimal crew collaboration, EMS on French tropical tuna purse seiners appears to be a promising tool for monitoring discards and non-target catch at an acceptable species identification resolution to supplement regional observer program.

The landing obligation in European fisheries: discard reporting by observer programs and automatic technology.

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<u>Fisheries observers and landing obligation</u>

Otter bottom trawl targeting demersal species in north Iberian waters is a mixed fishery which takes place throughout the year targeting European hake, anglerfish, megrim, horse mackerel and blue whiting. An standardized scientific observer program is already carried out to analyze and raise the data to obtain discard estimates for stock assessment. In this work, a dedicate observer program was set up to study the application of the landing obligation in coastal trawling fleet. The study involves both scientific oceanographic vessels and commercial vessels to characterize discards and record unwanted species occurrence. Observer trials and an automatic observer were used to test the potential use of discard recording by the fishermen and scientist to comply with landing obligation regulation.

The otter bottom trawl targeting demersal species in north Iberian waters is a mixed fishery operating in the Northern and Western coastal waters (ICES Divisions 8c and 9a). Two métiers operate on the continental shelf and upper slope from the southern Bay of Biscay to the northwest Spanish Iberian waters.

Otter bottom trawl targeting demersal species (OTB_DEF_>=55) in north Spanish Iberian waters (‘Baca’). This metier targets demersal species, standing out hake (Merluccius merluccius), megrims (Lepidorhombus boscii and L. whiffiagonis) and anglerfish (Lophius piscatorius and L. budegassa).

Otter bottom trawl targeting pelagic and demersal species (OTB_MPD_>=55) in Iberian waters (‘Gran abertura’) is a mixed bottom trawl fishery which takes place throughout the year. Horse mackerel (Trachurus trachurus) and mackerel (Scomber scombrus) are taken together with other species, mainly hake (Merluccius merluccius).

Vessels are from about 12 fishing ports: Galicia (A Coruña, Burela, Celeiro, Corme, Marin, Muros, Muxia, Ribeira, Vigo), Asturias (Avilés, Gijón) and Cantabria.

<u>Discard case study: Marin iSEAS on board sampling program</u>

Data from iSEAS observer program (2014-2016) in Marin fishing port trawler fleet at ICES 8c9a

Eight fishing vessels collaborate in the observer program and a total of 37 trips were carried out. We present results of discarding for the main commercial species in the trawl fishery and discard estimates for all the fleet in ICES 8c9a (Table 1).

- Vessels in Spanish waters discard mainly hake, blue whiting and mackerel with discard rates from 66 to 86%.
- Metier OTB_MPD presents lower discard rates.

- Vessels in Portugal waters discard pelagic species due to trip duration (3-7 days)
- Mean discards of the main eight quota species can reach 1442-7025 kg in a trip which must be landed at the Marin port.

Fishing ground	Metier	Species	Species	Kg Retained/trip	Kg Discarded/trip	Discard rate
NW Spain	OTB_DEF_>=55_0_0	*Lepidorhombus spp*	Megrims	292	260	47
NW Spain	OTB_DEF_>=55_0_0	*Lophius spp*	Anglerfish	86	0	0
NW Spain	OTB_DEF_>=55_0_0	*Merluccius merluccius*	Hake	95	185	66
NW Spain	OTB_DEF_>=55_0_0	*Micromesistius poutassou*	Blue whiting	136	367	73
NW Spain	OTB_DEF_>=55_0_0	*Scomber scombrus*	Mackerel	90	566	86
NW Spain	OTB_DEF_>=55_0_0	*Trachurus trachurus*	Horse mackerel	207	64	24
		TOTAL	TOTAL	904.49	1442.20	61.46
Fishing ground	Metier	Species	Species	Kg Retained/trip	Kg Discarded/trip	Discard rate
NW Spain	OTB_MPD_>=55_0_0	*Merluccius merluccius*	Hake	75	74	50
NW Spain	OTB_MPD_>=55_0_0	*Micromesistius poutassou*	Blue whiting	17	70	80
NW Spain	OTB_MPD_>=55_0_0	*Scomber scombrus*	Mackerel	733	28	4
NW Spain	OTB_MPD_>=55_0_0	*Trachurus trachurus*	Horse mackerel	2568	10	0
		TOTAL	TOTAL	3392.50	182.63	5.11
Fishing ground	Metier	Species	Species	Kg Retained/trip	Kg Discarded/trip	Discard rate
EU-Portugal	OTB_DEF_>=55_0_0	*Lepidorhombus spp*	Megrims	565	406	42
EU-Portugal	OTB_DEF_>=55_0_0	*Lophius spp*	Anglerfish	472	0	0
EU-Portugal	OTB_DEF_>=55_0_0	*Merluccius merluccius*	Hake	1156	411	26
EU-Portugal	OTB_DEF_>=55_0_0	*Micromesistius poutassou*	Blue whiting	30	793	96
EU-Portugal	OTB_DEF_>=55_0_0	*Scomber scombrus*	Mackerel	0	1395	100
EU-Portugal	OTB_DEF_>=55_0_0	*Trachurus trachurus*	Horse mackerel	44	4021	99
		TOTAL	TOTAL	2265.27	7025.98	75.62

Table 1. Catch (landings and discards) of main commercial species by quarter (mean catch in kg by observed fishing trip). Data from iSEAS dedicated observer program (2014-2016) in Marin trawler fleet at ICES 8c9a

<u>iObserver testing</u>

The IEO is being in charge of a standardized scientific observer program (random allocation) to analyze and raise the data to obtain discard estimates for stock assessment and complain with European data compilation schemes (DCF). In the LIFE iSEAS project, a dedicated trial program (non-random allocation) on board the fleet of the port of Marin (OPROMAR) has been carried out, simulating the application of this new rule to set up a case study of the application of the landing obligation in the mixed trawling fleet of Marin fishing port. Project LIFE+ iSEAS is carrying out the development of protocols for implementation and use of innovative technologies based on a test program with artificial vision devices for catch composition determination and data management technologies installed on board. Observer trials and an automatic iOBSERVER are used to characterize discards and record unwanted species occurrence and test the potential use of camera discard recording to comply with landing obligation.

Two main causes of discarding are fish discarded below the legal minimum landing size and discards attributed to fishers' responses to quota restrictions. The factors of discards amounts technical, biological, environmental, legislative, economic, cultural, social issues. To develop successful discard mitigation measures, it is necessary to better identify the reasons for discarding.

OTB_DEF_NW Spain	**MLS**	**DAM**	**QUO**	**MAR**	**VAL**	**NAL**	**QAL**
Lepidorhombus spp	96	4					
Lophius spp					100		
Merluccius merluccius	74	26					
Micromesistius poutassou	1	22			62		16
Scomber scombrus		3	0.5		97		
Trachurus trachurus		2	0.2		98		
Total	27	2	0.3	0	58	0	4
OTB_MPD_NW Spain	**MLS**	**DAM**	**QUO**	**MAR**	**VAL**	**NAL**	**QAL**
Lepidorhombus spp	100						
Lophius spp					100		
Merluccius merluccius	66	35					
Micromesistius poutassou					74		27
Scomber scombrus		13			87		
Trachurus trachurus		35			65		
Total	27	18	0	0	45	0	10
OTB_DEF_Portugal	**MLS**	**DAM**	**QUO**	**MAR**	**VAL**	**NAL**	**QAL**
Lepidorhombus spp	91	9					
Lophius spp	36	0			64		
Merluccius merluccius	78	22					
Micromesistius poutassou		0.4			44		56
Scomber scombrus			100				
Trachurus trachurus		1	99				
Total	10	2	76	0	5	0	6

Table 2. Reasons of discarding by metier. MLS: undersized, DAM: Damaged, MAR: No market, QUO: No quota, VAL: Low value, NAL: Species not allowed, QAL: Poor conservation

Conclusions

1. Discard patterns are different between different metiers. Discard patterns can differ between Marin vessels and other fishing port in the same area and metier.
2. Discard quantities changes through the year: it must be considered the changes in biomass and sizes must be in the implementation of landing obligation.
3. Small sizes and quota restrictions are two of the most important factors to achieve for the success of landing obligation.
4. Mean discards of the main eight quota species can reach 1442-7025 kg in a trip which must be landed at the Marin port.
5. The implementation of a discard ban should consider the characteristics and singularities of each metier, group of vessels and fishing port, as well as the legal conditions of each mixed fishery in terms of available quota for all target species.

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We would like to thank scientist, skippers and crew of Marin Fishing Vessels: Atardecer, Gonzacove Dos, Hermanos Soage, Nuevo San Cibrán, Pescarosa Cuarto, Playa do Castro, Portosanto, Ría de Marín, for kindly collaborate during iSEAS on board samplings by observers on board. Also thanks to J.C. Fraqueiro and F. Teijeira (OPROMAR-Marin). This work was made within the iSEAS Project financed by UE LIFE+

Lessons from EM Implementation in Diverse US Fisheries

Morgan Wealti, Jared Fuller

Saltwater Inc.

Saltwater is working in a range of EM programs throughout the U.S. that vary widely in purpose, scope, and cost. EM program objectives, funding sources, data requirements, and issues surrounding data ownership all affect the evolution of EM implementation (Table 1). This presentation focuses on lessons learned from EM program implementation in diverse fisheries.

The objectives of an EM program determine data requirements, and should lay the foundation for program design. Current programs in the U.S. focus on an array of objectives including scientific research, endangered species monitoring, skipper log validation, discard compliance, and full catch accounting. The level and reasons for vessel participation also influence project designs and outcomes. Voluntary and optional programs are important for testing new tools and procedures. Mandatory programs can create cost-efficiencies related to scale and longevity.

The selected sampling or “coverage” scheme will determine how much EM data is collected and how much is reviewed. Like observer programs, coverage plans can be based on vessel selection or trip selection with rates ranging from 10-100%. With EM programs however, trip selection can occur either before or after a trip. Pre-selecting trips reduces the amount of data collected and stored, and can increase industry “buy in” by reducing the impact on privacy. However, it may impact fishing behavior, replicating what is known as “the observer effect.” Setting coverage levels to achieve a scientifically reliable sample will vary by fishery, but must be driven by both science and cost considerations

EM programs can also differ in terms of who retrieves data, who conducts data review, whether the review is audited, what data is stored, how long data is stored, who owns the data, and who can access it. How much data is recorded, how much is reviewed, and how much is stored impacts data quality and program costs. A tight feedback loop between data reviewers, vessel operators, and technicians makes it easy to identify and correct system problems or crew behaviors quickly — which can impact data quality. Fishing industry members in many countries are concerned about public access to EM data. Who owns the data collected by EM systems can have significant privacy implications.

Fishery/Program	Project Objectives	Participation	Sampling Plan	Funding Source
Alaska Fixed Gear	Full Catch Accounting	Optional	Partial review of pre-selected trips.	NFWF/NOAA
Atlantic Pelagic Longline Tuna & Swordfish	Logbook Validation	Mandatory	Partial review of selected trips.	NOAA
Gulf of Mexico Shrimp Trawl	Protected Species Monitoring	Voluntary	Full review of observed trips.	NOAA
Atlantic Mid-Water Trawl Herring & Makerel	Discard Compliance	Voluntary	Full review of all trips.	NOAA
Gulf of Mexico Bottom Longline Reef Fishery	Research	Voluntary	Full review of all trips.	EDF/NOAA
Pacific Islands Longline Tuna & Swordfish	Full Catch Accounting	Voluntary	Full review of selected observed trips.	NOAA

Table 1. Range of EM programs demonstrating the need to consider multiple facets of each unique project when coming up with an EM program design.

Estimating Seabird Bycatch in Gillnet Fisheries in the Danish Øresund using REM

Glemarec, Gildas ; Kindt-Larsen, Lotte ; Larsen, Finn

DTU Aqua Denmark

Introduction

Gillnet fisheries, although highly selective, are also responsible for the capture of thousands of seabirds each year in Denmark. Reliable data on the subject are scarce, since the fleet consists mostly of unmonitored small-scale vessels (<15 meters). Using remote electronic monitoring (REM), we highlight the areas of high risks of seabird bycatch in the Øresund, the Strait separating Sweden and Denmark - a very important region for numerous migrating avian species. This work is a contribution to the European Union Plan of Action to reduce the impact of fishing on seabirds, and is planned to be extended to the rest of Danish coastal waters.

Methods

Data Collection

REM with at least 2 cameras per vessel, filming the sorting table and the area where the net breaks the water

3 Danish gillnet vessels operating in the Øresund

Data spanning from 2010 to 2018

Data Exploration

Data for each haul includes position, soak time, mesh size, net colour…

Bycatch data consist of species, position of the bycatch, sex, breeding status…

Data Analysis

Effort per vessel, per time of the year and per area

Risk maps

Model highlighting the influence of operational and environmental factor to explain the observed amount of bycatch

Results

1607 days at sea analysed

8485 unique hauls recorded

490 of bird bycatch identified

Among the 490 seabirds captured during the monitored period, ducks (Anatidae) were by far the most represented family (335 individuals, 68% of all catches), with the Eider duck *Somateria mollissima* alone making up nearly 80% of this amount. Cormorants (Phalacrocoracidae) came second (52 individuals, 11%), while guillemots and razorbills (Alcidae) closed the podium (39 individuals, 8%). Other birds, including 2 gulls (Laridae), 1 loon (Gavidae) and 1 grebe (Podicipedidae) were also captured (4 bycatch, <1%). Additionally, 60 birds (12%) could not be formally identified due to video failure.

Seabird bycatch was higher in fall and winter (83% of all catches), than in spring and summer (17%). The highest bycatch rates were observed in few areas (aka hotspots) in the fall-winter period, where ducks gather at sea in large numbers to feed on mussel banks.

Discussion

Remote Electronic Monitoring of small-scale gillnet vessels in the Øresund ensures the collection of high resolution data. Seabird bycatch would otherwise likely remain unnoticed in this fishery. REM is cost-effective and allows to obtain realistic estimates of bird bycatch in the area. By extrapolating our current findings to the rest of the fleet, we will determine the magnitude of seabird bycatch species-wise in the entire Øresund, and identify the spatial and temporal overlap (hotspots) between gillnet fisheries and seabirds.

Conclusion

This pilot study demonstrate the interest of using REM monitoring to assess the magnitude of seabird bycatch in Danish gillnet fisheries. Specifically, we could:

Assess the magnitude of bycatch of seabirds on a sample of three gillnet vessels operating in the Øresund, using data spanning from 2010 to 2018.

Identify the main factors to explain the observed levels of bird bycatch in gillnets in the Øresund (work in progress).

Electronic Monitoring Trials in Fiji and Ghana: a new tool for compliance

Netani Tavaga[1], Richard Yeboah[2], Papa Kebe[3], Julien Million[4], and Kim Stobberup[4]

[1]Offshore Fisheries Division, Ministry of Fisheries, Fiji,
[2]Fisheries Commission, Ministry of Fisheries and Aquaculture Development, Ghana,
[3]International Seafood Sustainability Foundation,
[4]Food and Agriculture Organization of the United Nations (UNFAO)

The Common Oceans Areas Beyond National Jurisdiction (ABNJ) Tuna Project is a GEF21-funded initiative, implemented by the Food and Agriculture Organization of the United Nations (UNFAO) in close collaboration with a large and diverse group of stakeholders – from industry to tuna Regional Fisheries Management Organizations, non-governmental organizations and international organizations – who play important roles in tuna fisheries. One of the important components of this Project is to strengthen and harmonize monitoring, control and surveillance (MCS) to address illegal, unreported and unregulated (IUU) fishing.

Among the many activities carried out by the Project, two pilot trials were carried out in Fiji and Ghana to test the use of electronic monitoring systems (EMS) as a tool for compliance, and complementing regular observer coverage.

<u>Advantages of EMS</u>

EMS offers key benefits, in particular regarding the monitoring of compliance during fishing, and can be used to complement existing observer programs and other monitoring tools. An observer at-sea can rarely be protected from possible pressure to misreport infractions that could lead to sanctions against the vessel operators. Image and video information can be used to prosecute a case of IUU fishing, provided that there is an adequate legal framework to allow for the admissibility of such information. On the other hand, EMS information facilitates reversing the burden of proof in fisheries and can be used to exonerate legal operators as well as document best practices. However, EMS should not be favoured over on-board observers as it cannot provide the same high resolution scientific information, and should therefore be considered a complement rather than a substitute.

EMS represents a secure, cost-effective and objective independent way to monitor approach to monitoring fishing operations. This technology is gaining increasing support as a complement to existing MCS tools such as VMS, observers, and port sampling. Trials have been carried out in both developed and developing countries. In the developed world, this includes Canada, U.S.A., Australia, New Zealand, Denmark, UK, the Netherlands, and Germany. EMS has also been trialed in tuna fisheries in the three oceans, involving both distant-water and national fleets.

<u>EMS pilots in Fiji and Ghana</u>

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21 Global Environmental Facility; www.thegef.org

To test the best way to incorporate this new monitoring technology to the MCS toolbox available, two pilot activities were set up under the framework of the Common Oceans ABNJ Tuna Project.

In Ghana, EMS equipment was deployed on the industrial purse seine fleet, consisting of 14 active vessels. The activity is implemented by WWF in close collaboration with the Fisheries Commission in Ghana, as well as technical support from the International Seafood Sustainability Foundation (ISSF) and UNFAO. EMS equipment includes 6 cameras recording 24/7 to monitor fishing operations on each vessel, including an incorporated vessel monitoring system (VMS) and sat-modem for geo-localization and communications. Since the launching of the pilot in September 2016, a total of 195 fishing trips have been monitored (as of June 2018).

In Fiji, the target is to reach the deployment of EMS equipment on 50 tuna longline vessels out of a total fleet of 89 vessels. As these are smaller vessels, EMS equipment is the so-called SeaTube Lite consisting of 3 cameras to monitor 24/7 fishing operations, including VMS and sat-modem functions. This is being implemented by the Offshore Fisheries Division of the Ministry of Fisheries in Fiji in collaboration with the Fiji Fishing Industry Association (FFIA) with support from UNFAO. Implementation started in October 2015 and a total of 310 fishing trips have been monitored (as of June 2018).

Expected outcomes

Both pilot activities will be completed by the preparation of national business plans that identify lessons learned during their implementation, and propose a means of ensuring continuity of the EMS implementation after the Project is completed. The business plan for Ghana has been completed and presented to the government and private sector, who supported the findings and indicated their agreement to contribute to the continuation of the EMS. The business plan for Fiji is still under preparation, but the private sector has already supported the idea of EMS beyond the life of the Project in 2019.

In summary, experiences and results from the overall Project activities have demonstrated that the transfer of new technologies can be done effectively when there is consideration of the context in which the new technology will be deployed. This includes the strengthening of the national institutions involved, establishing key partnerships, developing the required legal frameworks, and building the human resources necessary for the effective operation of the new technology. The overall aim of the pilots was not the test the technology itself, but to develop an effective implementation process at the national level, so that the information is properly utilized for compliance purposes.

An exhaustive sampling approach for fish data collection, using an automatic measuring system

César Santos Silva[1], Tiago Gaspar[1], Ricardo Aires[1], Maria Luísa Ramalho[1], Dália Reis[2], Hugo Diogo[2], Ângela Canha[2], João Gil Pereira[2]

[1]. Fishmetrics, Lda, Portugal,
[2] MARE Marine and Environmental Sciences Centre and IMAR Institute of Marine Research, University of the Azores, Portugal

Fish monitoring effort has been increasing over the past years, due to conservation and management requests demanding more and accurate data and consequently with raising costs. This is an important challenge especially for remote and disperse locations where fish sampling poses unbearable costs, leading to limited spatial sampling schemes, limited data on rare and occasionally landed species, as well as some erroneous and biased observations cases.

Figure 1. On the left: Scanner mounted above a scale; on the right: image acquired by the scanner, with some measures between 3D points.

Fishmetrics has developed a new autonomous system that can be installed on monitoring spots or on board fishing vessels, which is able to acquire remotely all the landed or captured fish, classify it, according to species and size, and measure it automatically without any physical interaction. The system uses a tridimensional infrared light system that is contactless, hence non-damaging for the fish. The identification and classification algorithm is based on Machine Learning. This system can capture all the fish data remotely, storing the information in a cloud database for future inspection and statistical analysis. This information includes not only fish images and a tridimensional map that enables the measuring, but also all relevant metadata (fish species, vessel identification, capture location, fishing gear and more).

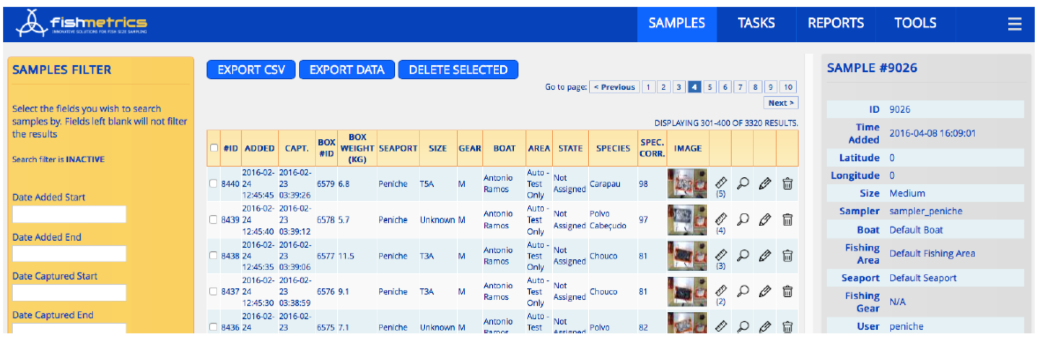


Figure 2. Screen of the Fishmetrics System Cloud browser application where the fish measurements are performed.

The aim of this work is to provide an overview of the system, its architecture and an analysis of the sampled data, by comparing the results of the Fishmetrics system with a traditional sampling methodology, in order to identify potential advantages of the system in relation to traditional data collection. Fishmetrics installed its system in Faial fish auction market working uninterruptedly for 18 months. However, the period of analysis was framed between July and August of 2016. The Fishmetrics system data was compared with Fisheries Data Collection Programme (FDCP) for the same period. FDCP requires the presence of on-shore samplers which collect fish lengths data daily at Faial fish auction market. The Azorean landings are generally multispecies, and many are classified within different commercial sizes. For that reason, the sampling scheme approach is stratified (whenever needed) according to the available métiers and commercial sizes categories at each day and landing, respectively.

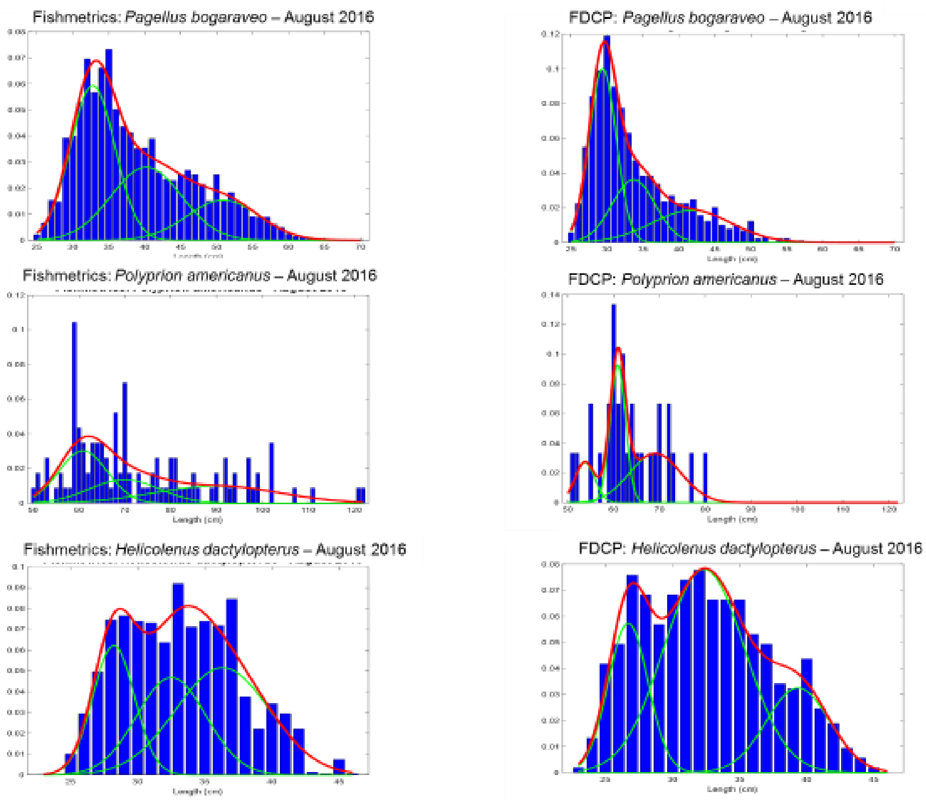


Figure 3 – Length histograms for the fish captured in August 2016, for three species. On the left: Based on Fishmetrics data; On the right: Based on FDCP data.

The comparative analysis reveals that the Fishmetrics system generates a more representative and robust sample of the captured fish and this is particularly relevant for species or sizes that were often under-sampled due to a limited number of occasional landings or available resources. The Fishmetrics system has three additional major advantages: it does not require the presence of samplers at the fish auction markets (useful for remote monitoring spots); the autonomous nature of the system leads to an exhaustive data collection; the data stored in the cloud database allows to re-measure any samples and to validate morphometric relations.

Abstracts of presentations that did not provide Extended Abstracts

Accelerating the Development of Automated EM Video Review through Competitions

Christopher McGuire, Benjamin Woodward, Kate Wing, Matt Merrifield

The Nature Conservancy

Automating Electronic Monitoring (EM) video review has the potential to revolutionize the fishery monitoring process; driving down costs, increasing coverage rates, and reducing the burden on human observers and video reviewers. One way to access data science and machine learning expertise, that might be otherwise cost-prohibitive, is through online open data competitions. Here we describe our experience using two data competition sites, Kaggle and DrivenData, to develop algorithms for automated EM. In 2017, our teams used EM video to create training data sets for the New England groundfish and Western Pacific tuna fisheries, and partnered with these data platforms to run first two known competitions focused on EM video review. Each resulted in first generation open source algorithms to identify, count, and measure fish that are publicly available. This presentation is intended to spark a discussion of current and future applications of machine learning tools in the EM process.

Monitoring of marine mammal and seabird bycatch by use of remote electronic monitoring (REM).

Lotte Kindt-Larsen, Gildas Glemarec and Finn Larsen

DTU Aqua, Technical University of Denmark

Quantification of marine mammal and sea bird bycatch is important in the context of conservation and management of protected species. Hitherto, using on-board observers has been the most reliable and accurate method. By law, however, many countries have to fulfill regulations on marine mammal and seabird bycatch monitoring but many fails due to the high coverages needed and high cost of observation. To reduce price and increase coverage closed-circuit television (CCTV) cameras have been used to document bycatch of marine mammals and seabirds in Denmark. From 2010 until today 6-15 Danish commercial gillnet vessels have every year been equipped with REM systems. The REM systems provided video footage, time and position of all net hauls and catches. All fishers have participated on voluntarily basis but have received additional quotas for their participation.

The results showed that REM system gave more reliable results compared to fishermen's registration since the bycatch of marine mammals, in many cases, had already dropped out of the net before coming on board. Furthermore, very high coverage at low cost was obtained with REM. Harbor seals, grey seals and harbor porpoises were easily identified on the video footage. With respect to seabirds identification was in most cases possible from the video footage but good conditions were needed for some species.

The bycatch and fishing effort data,revealed by the REM system, have been used to construct simple models explaining the relationship between the response (number of individuals bycaught), species density and fishing effort. The final model can thus be used as a tool to identify areas of high bycatch risk and support the conservation and management of the protected species.

European experiences on the use of Remote Electronic Monitoring

A.T.M. van Helmond, Lars O. Mortensen; Kristian S. Plet-Hansen; Clara Ulrich; Coby L. Needle; Daniel Oesterwind; Lotte Kindt-Larsen; Thomas Catchpole; Stephen Mangi; Christopher Zimmermann; Hans Jakob Olesen; Nick Bailey; Heidrikur Bergsson; Jørgen Dalskov; Jon Elson; Malo Hosken; Jan Jaap Poos

Wageningen Marine Research

Within the last decade, Remote Electronic Monitoring (REM) has emerged as a cost-efficient supplement to the existing expensive observer programmes documenting catches in commercial fisheries. An REM system consists of various activity sensors and a closed circuit television (CCTV) network to record catches without requiring extra personnel on-board. With the introduction of the landing obligation of the European Common Fisheries Policy, fishers are required to report all catches of quota regulated species. REM could thus become an appropriate instrument to monitor fisheries. However, despite its advantages over the existing monitoring methods, REM uptake has remained low in European fisheries and the approach is highly disputed. The objective of this review is to describe the state of play of REM in fisheries and to analyse the insights gained about the potentials of this technology for management, control and science. Since 2008, 11 REM trials were conducted in Europe, published in 19 publically available studies. These European experiences are also discussed in the global context of current REM use in other regions of the world. The review points out that REM allows for a substantially higher sampling coverage compared to current monitoring programs at equivalent costs. In addition, the technology offers a precise estimation of fishing effort, through high-resolution spatio-temporal data in combination with accurate recording of fishing activity. REM incentivises better compliance and discard reduction, and approaches to overcome the reluctance against on-board cameras are discussed. The article concludes that REM is a powerful and cost-efficient tool for monitoring fisheries.

Implementation of Electronic Monitoring on the West Coast of the United States

Brett Wiedoff

Pacific Fishery Management Council

In 2013, management agencies and the fishing industry on the West Coast of the United States (California, Idaho, Oregon, and Washington) began to develop an electronic monitoring (EM) program to estimate fish discards in catch share fisheries. We tested the program for several years, and in the spring of 2018, will phase out of special permits and into regulation. Participants will be able to use an EM system rather than a human observer to monitor individual fishing quotas (IFQ). National Marine Fisheries Service (NMFS, fisheries branch of U.S. Federal Government) will audit logbook data entries with EM to verify the type and amount of IFQ discards fishermen record. I will provide insight to the successes and challenges during the development of the program, and highlight the work to come that will streamline data analyses and reduce costs.

Success of an EM program begins with a simple objective. On the U.S. West Coast, the primary purpose is to monitor IFQ at-sea discards; it is not to replace scientific observers. I will discuss how we developed a focused objective and collaborated with the industry, enforcement, data managers, and EM providers to create a program that is now applicable across our catch share fisheries.

NMFS provided special permits to participants so that the fishery could operate as intended under future regulations. Testing the program components prior to full implementation solved several challenges and increased our chances of success. I will discuss how managers, enforcement, and the industry implemented a mock program then made adjustments to solve operational issues, create efficiencies, develop best practices, and troubleshoot accounting practices.

EM will be available to qualified participants but it comes at a cost to the industry. Fisheries with low bycatch or discards may save money over the cost of using an observer. Fisheries with multiple species and high bycatch can increase their flexibility in deciding when to fish; however, the cost may be similar to using an observer. I will discuss the operational aspects of these fisheries to explain how we customized the program to garner acceptance and reduce costs.

The Role of NGO Partnerships in Monitoring: Developments from the U.S. West Coast Groundfish Fishery

Melissa Mahoney, Shems Jud

Environmental Defense Fund

In 2011, the U.S. Pacific Groundfish trawl fishery transitioned to an Individual Fishing Quota (IFQ, or catch shares) program, requiring 100% monitoring of all groundfish trawl fishing activities, with both at-sea and dockside monitoring components. In 2013 the Pacific Fishery Management Council initiated a process to develop an electronic monitoring (EM) program. Flash-forward to 2018: EM is partially implemented and many fishermen are still paying upwards of US $500.00 per day for human observers, which for some vessels hardly allows for net profit. Full implementation of EM across gear sectors in the IFQ fishery is expected by 2019. This has been a huge lift by NOAA both nationally and at the regional level.

The Environmental Defense Fund (EDF) has partnered with fishermen and managers to develop the Pacific EM program by convening a national workshop (2014), initiating on-the-water pilot projects (2015-2018), and working to communicate the challenges fishermen experience in using EM with service providers and policy makers. In filling this role, EDF and other NGOs are helping NOAA fulfill its objective to provide cost-efficient and effective monitoring to this fleet of ~80 vessels by 2019.

Key outcomes that we will highlight in our presentation/poster include:

- Deeming of EM regulations by April 2016;
- Getting an EM EFP on the water by early 2016, maintaining the EFP thru regulatory implementation;
- Securing funding for EM system hardware, services and project management; and
- Addressing key design challenges such as how to accurately account for Pacific halibut discard mortality in absence of human observers; development of cost-effective video review rate protocols; storage policies; and adequate confidentiality rules for fishermen.

Electronic Monitoring in the U.S. West Coast and Alaska Groundfish Fishery

Courtney Paiva, Dave Colpo

Pacific States Marine Fisheries Commission

The U.S. West Coast groundfish trawl fishery, consisting of approximately 100 vessels, transitioned to an Individual Fishing Quota (IFQ) fishery starting in 2011. As a regulatory requirement, 100% at-sea human compliance monitoring was implemented to monitor discards of IFQ species for vessel quota debiting. Human monitors may reduce flexibility in the fishery, increase costs, decrease safety and sometimes eliminate the opportunity to fish if monitors are not available on short notice.

As an alternative, Pacific States Marine Fisheries Commission (PSMFC) and the NMFS West Coast Regional Office, working with the fishing industry and Archipelago Marine Resources, Ltd., began pre-implementation exploration of an Electronic Monitoring (EM) program in 2012. In 2014, the Pacific Fishery Management Council (PFMC) approved four Exempted Fishing Permits (EFPs) applications to allow participating vessels to fish with EM equipment on board in lieu of compliance monitors in the 2015-2016 and 2016-2017 fishing seasons. Based on the success of this work, NOAA Fisheries expects to put regulations in place for EM use in the fixed gear and whiting fleets in spring of 2018, and January 2019 for non-whiting mid-water trawl and bottom trawl fleets.

The North Pacific Fishery Management Council (Council) and National Marine Fisheries Service (NMFS) are in the process of integrating electronic monitoring (EM) tools into the Observer Program. This program was initiated to enable data collection in the small boat (40-57.5 feet length overall) longline and pot fleet; vessels where deployment of observers is more challenging primarily due to space limitations. In 2016, NMFS and the Council, commenced pre-implementation of EM into the longline fisheries, and began pre-implementation of EM into the pot fleet in 2017. Once EM is fully integrated into the Observer Program (operational program), data collected using EM will supplement the data collected by observers that is used to manage fisheries, in particular to estimate at-sea discards. In other regions, EM systems are used to collect data for compliance programs; the goal of this program is to collect data for the estimation of catch and subsequent in-season management of fisheries.

This poster provides updated data for 2017 Alaska Fixed-Gear, 2017 West Coast EFPs, as well as results from two EM projects conducted in 2016: bottom trawl discard study; and fixed-gear total catch accounting study.

Session 11. The future of monitoring programs

Leader: Andrew France

This conference has shown us that, worldwide, there are already a number of different types of monitoring programs, designed and structured in a variety of ways. As demand increases for information and data from monitoring programs, so does the uptake of new methodologies and technology to provide electronic reporting, geospatial information and electronic monitoring. This session identified changes that have already occurred in some programs, explored some of the types of monitoring programs that will potentially exist in the future and provided insights for new or emerging programs and the challenges that they face.

Oral Presentations - Extended Abstracts

Scottish Experiences in the Use of CCTV for Scientific Data Collection and Analysis

Rachel Kilburn

Marine Scotland Science, Aberdeen, Scotland

Introduction

REM data has been used extensively by Marine Scotland Compliance (MSC) during 2008 and 2016 as part of the management and enforcement measures in the Conservation Credits and Catch Quota schemes. However, the scientific analysis of such data is at a much earlier stage of development. The use of REM to monitor mixed species trawl fisheries is a more recent development, and the capabilities of the system in this context are not yet fully understood. Therefore, there is a pressing need for scientific analysis of REM data, both to evaluate what can be learned of the fish stocks and the fishing industry from these data, and to help inform best practice in compliance monitoring operations. While further development work is certainly needed, REM provides a rich source of fisheries information for science as well as for compliance and management.

Areas of Work and Research

Here we summarise (in brief) the scientific analyses of Scottish REM data that has been conducted by Marine Scotland Science (MSS) at the Marine Laboratory, along with proposals for future work. All analysis is performed with Archipelago Marine Research Ltd, EM Interpret™ data review software, and the University of East Anglia for the Automated Image Analysis. The work covered includes.

- Fish identification: A structured training programme has been developed to ensure that there is quality and compatibility between analysts in the identification of six commercial important species for Scotland; cod (*Gadus morhua* L.), haddock (*Melanogrammus aeglefinus* L.), whiting (*Merlangius merlangus* L.), saithe (*Pollachius* *virens* L.), hake (*Merluccius merluccius* L.), and monkfish (*Lophius piscatorius* L. and *Lophius budegassa* S.).

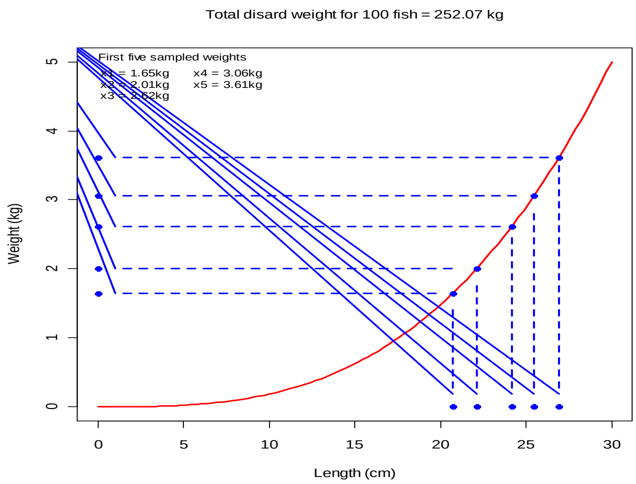
- Observer vs Electronic length measurements:

A useful aspect of REM is that length measurement software can be applied to the discard footage. This study aims to define an accurate method of ‘best practice’, for estimating length data from video footage provided by REM.

- Discard rate estimation:

As we cannot measure weight from CCTV video, we must apply externally estimated length–weight relationships; however this is quite an unsophisticated procedure. Here we give a preliminary analysis to obtaining the discard rate estimation.Given a length-weight relationship we can generate weights for each of the sampled lengths. Sum these to get the total weight of that sample. Compare with the weight of fish landed from that trip to estimate discard rate (Fig 1**)**.

Fig 1. Discard Rate Estimation
(Dr Coby L. Needle. Marine Scotland Science)



- Comparing the Costs of Onboard Observes And Remote Electronic Monitoring (REM): A Scottish Case Study:

The cost analysis of the relative costs of on-board and REM observation section takes real cost data for at-sea observers and the REM observation programme, and applies a simulation approach to estimate the likely overall costs of four observer system.

- **Automated fisheries analysis for fisheries CCTV**:

The computer assisted video analysis system (Fig 2.) is being developed by a team at the School of Computing Sciences, University of East Anglia. The research focuses on image analysis and machine learning using digital images of fish and other objects on the sorting belt. The work will investigate various strategies for overcoming the challenges that affect the performance of automated fish recognition: noise, occlusion, position and pose of fish and “will produce estimates within a statistical framework” (French et al, 21015). The project will focus on the development of machine learning detection algorithms focusing on six commercially important demersal species for Scotland; cod, haddock, whiting, saithe, hake and monkfish.

Fig 2. Interim results: Segmentation of fish from foreground

https://www.uea.ac.uk/computing/graphics-vision-and-speech/automated-image-analysis-for-fisheries

- Future work

Plans for future work with REM data have been outlined in four main contexts: a wide-ranging research project to be carried out by MSS; these are outlined below.

- Understanding the effects of REM on fleet dynamics in the Scottish demersal fleet.
- SMARTFISH funded by Horizon 2020.
    - First part;
        - Collecting footage and providing it to the UEA to train the image analysis system.
        - Computer vision technologies, for counting Nephrops burrows on the sea bed, and counting and aging scallops.
    - Second part;
        - Testing these technologies in fisheries research cruises of the northern North Sea and West of Scotland

References:

Roasanne Dinsdale: 7th International Fisheries Observer & Monitoring Conference, 8-12th April 2013, Chile

French, G., Fisher, M., Mackiewicz, M. & Needle, C. T. In Amaral S. Matthews, T. P. S. M. & Fisher, R. (Eds.) [Convolutional Neural Networks for Counting Fish in Fisheries Surveillance Video](), Proceedings of the Machine Vision of Animals and their Behaviour (MVAB), BMVA Press, 2015, 7.1-7.10. Note: Best paper Award.

National Survey Results of U.S. Fishery Observers

Yuntao Wang[1,2], Jane DiCosimo[2]

[1]Second Institute of Oceanography, State Oceanic Administration, Hangzhou, ZJ, China, [2]National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Spring, MD, USA

NOAA Fisheries manages fourteen regional fishery observer programs that deploy observers on 53 fisheries on all U.S. coasts (Figure 1). Since the first U.S. observers were placed on foreign commercial vessels in 1971, NOAA Fisheries and observer provider companies have trained and deployed as many as ten thousand biologists in dozens of U.S. commercial fisheries. The high-quality data observers collect are used to monitor catch and bycatch, assess fish populations, set fishing quotas, inform management, and report non-compliance with regulations.

Observers may spend days, weeks, or months aboard commercial fishing vessels and receiving vessels. An observer's work is intense and the conditions onboard may be uncomfortable therefore taking action to maintain a strong and safe observer workforce is a priority for NOAA Fisheries. Lack of empirical data however may limit the ability of national and regional programs to effectively retain observers and evaluate their behavioral responses to changes in regulations, recruitment, data collection, and field conditions.

In 2016, NOAA Fisheries conducted an informal, nationwide survey of observer attitude and experiences, as one part of the agency's multi-phased plan to evaluate and improve its observer safety program. The goal of collecting this information is to improve understanding of the motivations and perceptions of current and former observers and apply that information to recruitment and training in the regional observer programs. Improving observer retention may lead to a decrease in training costs, increased safety, and continued growth of a cadre of high quality observers.

The anonymous, online survey collected data from 553 past and present observers, including demographics, education, longevity, career plans, job satisfaction, job difficulties, safety (including harassment) incidents, experience in international fisheries, use of electronic technologies in fisheries monitoring, and regional issues. Survey responses came from 17 strata of region and fishery combinations.

Eighty-seven percent of respondents had a bachelor's degree when first starting as an observer, along with another ten percent who had already obtained a master's degree. Of those respondents who began observing with a bachelor's degree, 16% subsequently earned a master's degree.

Almost all respondents indicated that they expected to spend five years or less as an observer, although a majority reported that their tenure had either matched or exceeded their initial expectation. Respondents reported an average tenure ranging from just over 3 years in the Greater Atlantic to 5.5 years on the West Coast (Figure 2). The average length of tenure was less than four years. The survey also indicated that observers tend to start their career at a young age. The largest share of respondents (40%) was between 20 and 29 years old, followed by those aged 30 to 39 (33%), with continuing declines for older observers. The survey also found a statistically significant higher proportion of male observers at older ages.

Respondents identified a number of professional reasons for becoming an observer, including obtaining fieldwork experience, career development or advancement, and protecting the environment. Some reasons could be perceived as personal, including "contact with ocean," "adventure," and travel opportunities. Still others cited pay, seasonal work schedule, and ability to fill educational or employment gaps as the key reasons for becoming an observer. Nearly 75% of respondents noted that their experiences as an observer had been or would be helpful in advancing their subsequent careers; 69 percent said their expectations for their sea day deployments matched their experience and 45% felt that working as an observer increased their interest in working in marine science careers.

To measure job satisfaction, the survey asked about observer interactions with NOAA Fisheries staff, provider company employers, and captains/crew, along with amount of time deployed at sea. Overall, satisfaction with these general categories fell between neutral and satisfied. Respondents generally were satisfied with the number of days spent deployed during a month, with 69% responding that the number of sea days was what they had expected. Another 19% responded that deployments were too few, while 12% reported too many deployments. Key areas of dissatisfaction included the lack of outreach and opportunities to attend professional conferences, inadequacy of health insurance offered by provider companies, and conditions of accommodations on the vessels.

Respondents also addressed harassment and safety incidents and their experiences in reporting such incidents. Nearly half (46%) of respondents reported experiencing harassment at least once during their tenure, with 33% of those respondents reporting an incident every time they experienced harassment, 40% reporting some of the harassment incidents they experienced, and 27% never reporting an incident. The survey questions purposefully did not define harassment therefore those incidents reported in the survey could be anything from an unwelcome stare to physical or sexual assault.

Survey results provided needed clarity on factors that contributed to observer retention to ensure that NOAA Fisheries has the necessary information it needs to support robust observer programs and ensure observer safety and health. NOAA Fisheries is responding to information reported in the survey to improve the national and regional observer programs to retain highly qualified, trained scientists, support observers in their career development, increase their recognition by the fishing community, and most importantly, to keep the safe.

Agency actions include:

- Ensuring recruitment and training materials set appropriate expectations of the observer experience;
- Communicating career path opportunities and help observers transition to other fishery-related career opportunities;
- Effectively communicating the intent of electronic technologies to augment regional observer programs;
- Increased funding for observers to attend conferences; improved training and communications; and implementation of national regulations for observer provider insurance requirements

- Better educating the fleet, Councils and other stakeholders about observer contributions to sustainable fisheries management
- Surveying Alaska observers on safety and harassment violations and factors that impede disclosure;
- Ensuring that NOAA fully implements its Sexual Assault and Sexual Harassment Prevention and Response Policy in observer programs by improving training to identify and report all forms of harassment.

The full report of survey results is at https://spo.nmfs.noaa.gov/tech-memos.

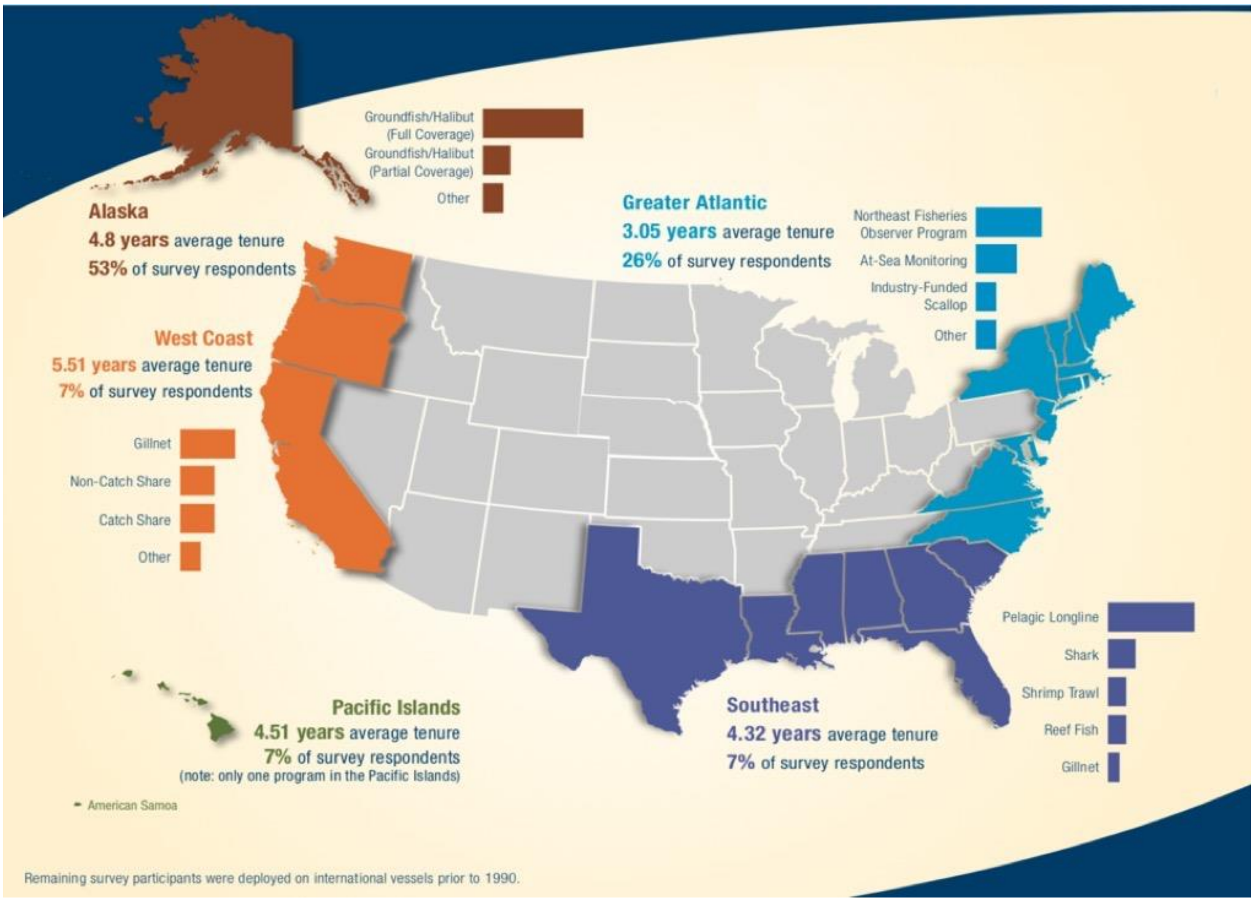


Figure 1. Average regional observer tenure and response distribution by U.S. regional observer programs

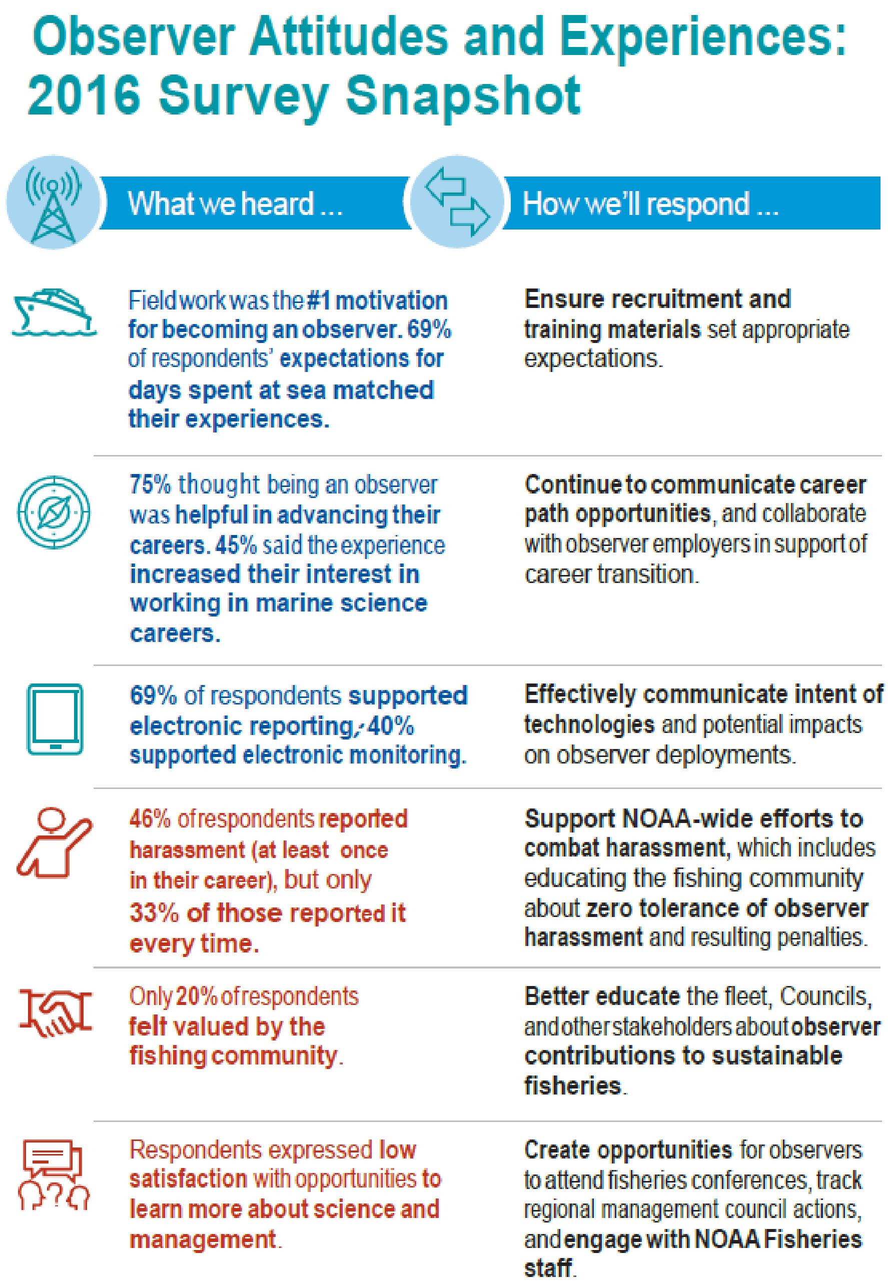


Figure 2. Summary of U.S. observer survey responses

The Future of Fisheries Monitoring

McElderry, H. and M. J. Pria

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Today's modern commercial fisheries struggle to satisfy the information requirements of management, science, market, business operations and social license. These information needs are met in a variety of ways, but independent monitoring is often considered the gold standard because a dedicated, unbiased data collection effort is used, creating comprehensive, verifiable fisheries-dependent data, resulting in greater fishery transparency. The most commonly used tools for independent monitoring are observer programs and, more recently, electronic monitoring (EM). These tools are employed in various ways across a wide range of fisheries, each application having different strengths, limitations, operational needs, and costs. With the growing demand for independent monitoring and our understanding of the operational complexities of these programs, we explored the potential for independent monitoring to scale in a future setting with an ever-growing interest in providing transparency in commercial fisheries.

In practice, independent monitoring is limited in scope on a global scale. We reviewed global fisheries information22 and applied estimates of fleet activity to estimate the overall scale of fisheries. Worldwide, there are nearly three million motorized fishing vessels, which we conservatively estimated to fish a total of about 200 million days. Among this world fleet, those under 12 meters in length make up 85% of all vessels and about two-thirds the total fishing days. By region, Asia makes up about 80% of the fleet, followed by Africa (6%) and South America/Central America (7%). Europe and North America make up a relatively small portion of the world fleet, each at about 3%. Information about independent monitoring programs is not easily available but some trends are evident. In general, many fisheries are not monitored and those that are have very low sample rates. While full or even partial monitoring may not be required in many instances, the list is long of fisheries with inadequate levels, given their information requirements. Canada and the United States have significant levels of independent monitoring, each with nearly 100,000 days monitored, yet we estimate coverage level across all fisheries in these countries at less than 10%. Coverage levels in European fisheries is less than 2%, elsewhere much less. While there are some highly monitored large industrial fisheries such as some tuna purse seine and factory trawl fleets, this pales in relation to the far larger fleets where little or no monitoring occurs. While a rough estimate, we suggest that global observer-based monitoring is no larger than 200,000 vessels and 2 million fishing days while EM coverage is much smaller at about 1,000 vessels and 50,000 days. Thus, on a global scale independent monitoring, as it is currently applied, only reaches a small fraction of vessels (6%) and fishing days (1.5%).

Despite the growing interest in independent monitoring, increased coverage is often impractical for multiple reasons, cost being the most significant. Observer program cost per fishing day may run 4-6 times the observer wage23 when accounting for all aspects of the program (training, lay days, equipment, travel, data processing, overheads, etc.), making these programs too costly for most fleets to bear without significant external funding. EM may offer savings over observer programs, yet these programs are complex, requiring costly EM equipment and considerable manual effort to manage the field data collection effort

22 FAO. 2016. The State of World Fisheries and Agriculture 2016. Contribution to food security and nutrition for all. Rome 200 pp. Available at: www.fao.org/3/a-i5555e.pdf.

23 Observer wages vary but they are generally considered to be a mid level field technician, which would be like a senior crew member or junior vessel officer. Observer programs are often expressed as a cost per sea day (vessel day at sea) and a more universal way of expressing observer program cost is as a multiple of the observer wage.

and conduct data review. EM programs may therefore only offer savings of 50-80% over an observer program. Technology advancements such as automated image processing may create additional efficiencies to reduce labor requirements and lower program costs, but such advancements appear to be several years from operational implementation.

Likewise, vessel size is a key limiting factor for expansion of independent monitoring programs. In terms of numbers of vessels, the under 12-meter length fleet represents the vast majority of global fishing as compared to larger vessels of industrial fisheries where independent monitoring is more common. Observer deployments on these smaller vessels is problematic, not only for space considerations but also because vessel activity schedules are more weather dependent, making observer deployments logistically more challenging and costlier as compared to deployments on larger vessels. EM is widely seen as the only practical solution for small vessel fleets as the technology is quite adaptable to small vessels, provided electrical power is available.   A few programs have successfully demonstrated the use of EM on small vessel fleets, including open boats powered by outboard motors. However, while technically feasible for small vessels, EM is likely out of reach for many because vessel earnings do not support the monitoring program costs.   Thus, independent monitoring is only available to wealthier fleets which are predominantly large vessel fleets, or fleets that have significant external funding.

While one could argue that independent monitoring is generally underfunded, we believe that the mismatch between the information aspirations and the overall scale of monitoring is not solved by simply increasing funding.   We also do not believe that wider application of EM will be achieved simply through technological advancement. It is a very positive sign that there is wide acceptance among diverse stakeholder community that technology-based solutions for independent monitoring can be successful. However, the expanded use of EM will depend on much more foundational changes. Significant but often ignored among these are the people-related changes, not technology.   In our view, top-down program governance will not be as effective as programs where harvesters are engaged and carry a significant level of individual responsibility. Governing and conservation groups express frustration with the lack of uptake by harvesters for improvements to monitoring, yet provide little real opportunity for harvesters to participate, plan and operationalize these systems. We believe harvesters need to be more directly engaged in data collection process. Many monitoring programs regard harvesters as being too busy; we reject this notion. Participation in catch accounting not only builds greater awareness of total fishery removals but leads to the use of EM as an audit tool, as opposed to a 'black box' primary data collection tool, separate from harvesters. This approach will also provide the avenue to build fishery data sets that serve both industry and agency purposes, further building engagement in the program.   Furthermore, control agencies will be less effective than consumers in driving acceptance among harvesters. In our view, there is a wide gap among consumers in understanding the sustainability benefits from fishery certification, seafood ratings systems and fisheries transparency through independent monitoring.   Finally, many users approach EM programs from the design mindset of observer programs, while we believe a far more nimble approach is needed. EM has to be viewed as a different technique with its strengths and weaknesses rather than being perceived as the poor-sibling substitute for observers. Fishery managers must learn to treat management, enforcement and research as a suite of elements that have to be tailored to the monitoring realities as well as tailoring monitoring to meet their data needs.   Agency-led observer programs often involve the private sector as an employment convenience (observers are agency representatives), whereas EM programs place far more dependency on private sector for innovation, product development and service provision. We believe more attention is needed to intensify private sector involvement.

Looking to the future, we believe that there will continue to be significant growth in independent monitoring for higher valued industrial fisheries, and small-scale fisheries that can secure external funding. Putting this into perspective on a global scale should dampen expectations for high penetration of independent monitoring. We believe that independent monitoring will remain out of reach for the vast majority of world fisheries. We believe that EM will have a very significant role in the growth of independent monitoring and have identified some of the key limiting factors to enable growth, in particular the human issues. We believe the greatest growth of independent monitoring could occur in fisheries where harvesters take a quality systems management approach. In these, data collection needs would become internalized into routine operations and verification procedures through EM and other remote data collection to ensure veracity of self-reported data systems. Growth will also occur in fisheries where there are strong linkages with consumers whose sustainability expectations are more clearly tied with fishery transparency. The role of the consumers is really key because if industry sees this as an expectation, they'll just make it happen to stay ahead of the problem, rather than waiting for government to find the wherewithal to enforce it.

Open Discussion Session

Q – EM seems to clearly be the "way forward". But we are not seeing it because fishers apply pressure to stop it. So can a market-based approach assist?
A – In New England, USA, markets are not involved. But in time, one could see that the involvement of seafood buyers in supporting EM could assist in its implementation.
A – Markets have not been involved, and compliance has been a focus. While there has been lots of workshops, there is a need for more high level decisions to be made regarding EM. As well as a need for setting standards.
A – It is also important to note that fishers' attitudes towards EM are very different to their attitudes regarding Electronic Reporting (ER).

Q – It seems that if fishers own EM data, how can we add/promote transparency?
A – Fishers need to share their data – not "choose" to share it.
A – A co-operative approach is suggested as a way forward
A – It becomes an issue of supply-chain legalities. There is a growing awareness that the data can be obtained and shared. So we need new models for data sharing and standards for doing so.
A – 1500 years of history places the ownership of the resources we are discussing as public and the responsibility for managing them is given to the government by that public. So when discussing data usage, we need to think broader (and bigger picture) than co-operative data sharing models - the government is responsible for it.

Q – Regarding software development, is there is a need for open source software so that Apps are shared to all?
A – Good in theory but the problem is that open source will lead to little incentives for developing and innovation in software. Software needs a "house" and for providers to make a profit otherwise it will stagnate.

Q – A question of scale in fisheries monitoring. Most boats in the world are <12m, so clearly we need to ramp up monitoring of small-scale vessels.
A – As the technology in EM gets smaller, the technological monitoring of small vessels should be able to be increased. We saw an example of this from Indonesia on tiny vessels using small cameras.

Q – Clearly we need standards for EM at a national/RFMO level. But this is difficult. Countries do things differently. So we end up with minimum standards on equipment, review, analysis and program designs. This leads to a "low" standard – set at the lowest common denominator – but it's the reality when dealing with multiple countries in a region.
A – Globally, perhaps we should look to "harmonization" – not mandatory/legislative standards.

Poster Presentations – Extended Abstracts

The Vital Role of Observer Specimen Collections in the Advancement of Trophic Ecology

Nathan Mertz

Fisheries Observer, Frank Orth & Associates

NOAA Fisheries West Coast Regional Observer Program (WCROP) currently covers 4 fisheries, with the majority of fishing vessels landing within 200 miles of program headquarters. The program supplies fresh tissue samples (stomach, liver, muscle, gonads, blubber, adrenal gland, gills etc) from numerous fish and marine mammal species to the Southwest Fisheries Science Center (SWFSC) by working closely with researchers to frequently update collection protocols, train observers with up to date techniques, and provide specimen specific collection and storage equipment. Over the last decade, these collections have come at the request of scientists from NOAA's laboratories as well as academic institutions worldwide, helping to generate groundbreaking publications.

Blubber samples taken from Cetaceans and Otariids have been used to establish baseline progesterone and testosterone levels for detecting pregnancy and reproductive status in 5 species of female and male marine mammals (Kellar et al. 2009, Trego et al. 2013, Beaulieu-McCoy et al. 2017). Additionally, skin and blubber tissues collected during at-sea dissections have been used to detect significant changes in the California Current food web during the El Nino Southern Oscillation (Chivers et al. 2016, Ruiz-Cooley et al. 2017) and establish new methods for preserving samples for long term stable isotope comparisons (Newsome et al. 2017). This lab group is also currently studying growth and reproduction of *Delphinus* *spp.* off the California coast using gonads, teeth, and length measures collected by observers.

Collection of DNA samples from Opah (*Lampris spp.*) by observers in the North Pacific and around the world has led to the characterization of 2 distinct species (*L. incognitus* and *L. megalopsis*) within the US based fisheries, and 6 separate species worldwide. (Underkoffler et al. 2018, Hyde et al. 2014)

Stomach and spiral valves of Shortfin Mako (*Isurus oxyrinchus*), Common Thresher (*Alopias vulpinus*), and Blue (*P. glauca*) Sharks collected by observers were analyzed, showing distinct dietary differences between the species, despite overlapping ranges and similar life history characteristics. (Preti et al. 2012). The diets of Bigeye Thresher Shark (*Alopias superciliosus*), Swordfish (*X. gladius*), and 4 Cetaceans (*D. delphis, D. capensis, L. obliquidens, L. borealis)* are also being studied as part of a PhD thesis by A. Preti on the trophic ecology of these 9 top predators in the California Current.

Detailed documentation of release condition of Blue Sharks (*Prionace glauca*) , and the deployment of PSAT tags over multiple years provided the data necessary for development of post-release mortality estimates for *P. glauca* in the California Drift Gillnet fishery. (NMFS data, publication forthcoming)

Adult and sub-adult Swordfish (*Xiphis gladius*) otoliths collected by observers in California, Hawaii, and Mexico were micromilled and chemically analyzed to determine their trace element concentrations. After comparison to young-of-the-year swordfish otoliths sampled from 4 nursery habitats across the North Pacific Ocean, it was determined that the majority of individuals were contributed by the Central Equatorial North Pacific region. (Quesnell 2017)

Muscle and liver tissue specimens collected from 4 species of young of the year, juvenile, and mature sharks; White (*Carcharodon carcharias*), Salmon (*Lamna ditropis*), Shortfin Mako (*I. oxyrinchus*), and Common Thresher (*A. vulpinus*) were used for analysis of mercury and organic contaminant levels (Lyons et al. 2013).

Despite a small program size, the scientific impact of specimen collections from the WCROP displays the benefits of observer data and specimen collection within the many fields of fisheries management, marine biology, and oceanography. Development of electronic monitoring technologies promises to further benefit the scientific community and observers both. Fulfilling duties such as compliance and protected species monitoring, these systems will compliment at-sea observers, allowing them more time to complete scientific tasks such as the measurement of physical characteristics and collection of biological specimens. These tasks are necessary for the study and discovery of marine species. The databases built from the information gathered will continue to better our management of living marine resources by using an ecosystem-based approach.

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Can an alternative fishing method save a California fishing heritage? The deep set buoy gear approach

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Swordfish off the coast of California are harvested at rates well below the harvest guidelines for the stock. For most of the past 40 years the Large Mesh Drift Gillnet (DGN) fishery has been the primary method of harvest. The DGN fishery has adapted to numerous regulatory changes. These changes are intended to address bycatch of marine mammals and sea turtles and to shift the fishery from a thresher shark fishery, to a swordfish fishery.

The National Marine Fisheries Service (NMFS) West Coast Region (WCR) has observed the DGN fishery since 1990. The numerous regulatory changes to the fishery has reduced the fleet from around 300 vessels in the mid 1980's, to only 20 active vessels today.

A major problem with this reduction in active vessels is that the fishing culture is not being passed on to future generations, due to most DGN fleet captains being close to retirement, with few new entrants. One potential solution is to develop a new fishery to supplement the DGN swordfish fishery in order to supply local west coast swordfish to California.

Over the last several years the Pfleger Institute of Environmental Research (PIER), along with a group of DGN and Harpoon fishermen, have been developing a new gear that can target swordfish with limited bycatch.

This gear is called Deep Set Buoy Gear (DSBG) and is modeled after similar gear being used off of Florida and modified to the unique aspects of our west coast/California ecosystem. If the development and implementation of this gear continues to be successful, it would allow for a locally sustainable and profitable California swordfish fishery with minimal bycatch and protected species interactions, to thrive for generations to come.

The West Coast Regional Observer Program (WCROP) has been involved in the development of the fishery for several years. Observers are currently being placed on participating Exempted Fishing Permit (EFP) vessels as the fishery moves towards becoming an authorized fishing gear on the west coast.

<u>Drift gillnet facts</u>

- In 1997 National Oceanic and Atmospheric Administration (NOAA) Fisheries adopted the recommendations of the Pacific Ocean Cetacean Take Reduction Team (POCTRT), requiring pingers, net extenders, and mandatory workshops for skippers in the DGN fleet.
- In 2001 NOAA fisheries established two large conservation areas off the coast of California and Oregon to protect endangered loggerhead and leatherback sea turtles.
- DGN fishing is prohibited in the conservation areas at times when sea turtles frequent the areas, thereby closing large areas to the fishery for a portion of the year.
- An annual closure extends from northern Oregon to Central California to protect leatherback turtles' seasonal foraging areas, while another closure in the Southern California Bight (SCB) is triggered during warmer-than-normal water temperatures to protect loggerhead sea turtles that may be present.
- The number of vessels participating in the DGN fishery has dropped by approximately 90 percent since the 1990s to just 20 vessels in 2018. The decline is in part the result of limitations on the fishery to protect other species, such as

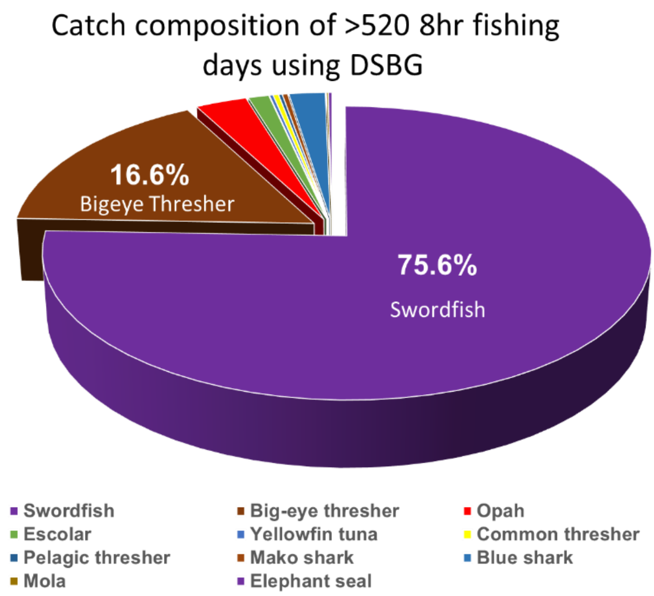
prohibiting DGN fishing in the Pacific Leatherback Conservation Area (PLCA), which was historically an area of high swordfish production.

Deep set buoy gear facts

- Research trials were conducted between 2011 – 2014 with a research vessel and five cooperative fishing vessels. The EFP was issued in September 2015 and to date has landed 611 swordfish over 3498 hours of fishing days.
- Research trials under Stahl Kennedy (SK) and Biological Reduction Engineering Program (BREP) grants are ongoing for DSBG from the RV Malolo.
- Overall, six individual cooperative fishing vessels have participated in the DSBG EFP trials between 2015 and 2017. Catch rates have varied by vessel and year with an overall average of 1.75 swordfish/8hr day and an average market price of approximately $7.50/lb via selective marketing.
- Swordfish have comprised over 70 % of the total catch composition, with a 96% marketable species catch rate, i.e. other marketable HMS with only two interactions with elephant seals (released alive) during EFP fishing.
- The Pacific Fisheries Management Council (PFMC) continues to solicit DSBG EFP applications suspended until June 2019. This action addresses data gaps to inform discussions regarding development of a range of alternatives to fully authorize DSBG under the Highly Migratory Species (HMS) Fisheries Management Plan (FMP). NMFS is currently conducting analysis to issue DSBG EFPs to 62 additional vessels.

Conclusion

Through the issuance of HMS EFPs to selectively target swordfish and minimize bycatch and protected species interactions, NMFS WCR, Sustainable Fisheries Division (SFD) HMS branch, is the acting agency responsible for funding the program in its endeavors to build a thriving and resilient west coast swordfish fishing community. Facilitating development of a robust west coast swordfish fishery is expected to increase west coast production, provide additional job opportunities in the fishing industry, reduce the trade deficit of swordfish with increased west coast supply of locally caught fresh fish, and reduce the carbon footprint of swordfish delivery with domestic production that meets U.S. national standards.
In the case of DSBG EFPs, it’s a unique collaboration between scientists, fishermen, and NMFS to apply the unique daytime habitat exploitation of swordfish to selectively target them and avoid incidental catch of protected species which utilizes other pelagic habitat zones.



Total Deep Set Buoy Gear catch from research and cooperative fishers from 2011 - 2016. Schematic representation of Deep Set Buoy Gear

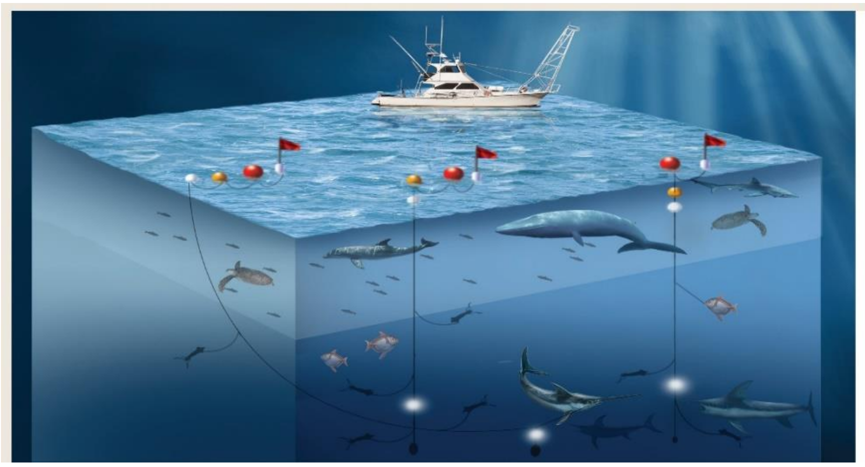


Image courtesy of PIER

Testing the effectiveness of electronically monitoring catch retention in the midwater trawl atlantic herring and mackerel fisheries of the Northeast US.

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NOAA Fisheries, USA

Background

Electronic Monitoring (EM) is increasingly being used as a tool for catch monitoring and reporting compliance in fisheries around the world. There are several EM initiatives and programs underway in the United States, but full program implementation in the Northeast remains limited. As part of the Greater Atlantic Region's Electronic Technology (ET)

Implementation Plan, the New England Fishery Management Council (NEFMC) and the National Marine Fisheries Service (NMFS) are considering implementation of EM in the Atlantic herring midwater trawl fishery to improve catch monitoring. The IFM amendment evaluates how different coverage target alternatives meet the specific monitoring goals identified by the New England Council while comparing the costs of the monitoring programs, particularly costs that would be borne by the fishing industry. The herring coverage target action alternatives include Northeast Fisheries Observer Program-level (NEFOP-level) observer, at-sea monitoring (ASM), EM, and portside sampling (PS) coverage. Because midwater trawl vessels discard only a small percentage of catch at sea, EM and portside sampling have the potential to be a cost effective way to address monitoring goals for the midwater trawl vessels harvesting herring. EM would be used to verify retention of catch on the midwater trawl fleet and portside sampling would be used to verify amount and species composition of landed catch.

<u>Summary of Data Findings</u>

- Data was collected on 192 trips across the 11 actively fishing midwater trawl vessels.
- These data were initially reviewed by both Saltwater and a secondary review was performed by NMFS reviewers; Saltwater staff performed a comprehensive 'census' review while NMFS staff performed a shorter 'audit' that focused exclusively on fishing events.
- 'Dual reviews' were successfully completed on 126 trips (i.e., both 'census' and 'audit' reviews were completed).
- Of the 126 dual reviewed trips in this study, 32 trips (25%) had overlapping Northeast Fisheries Observer Program (NEFOP) coverage.
- Video reviewers were tasked with identifying and documenting discard events to determine what information could be consistently gathered and which types of discard events could be accurately categorized using EM. Please refer to *Appendix 1* for descriptions used by reviewers to categorize discard events.
- In total, review staff performed more than 1,000 hours of video review and catalogued 1,461 discard records (902 census reviewer records, 559 audit reviewer records).
- Of the the discard events as reported by the audit review, the most frequently assigned category was "discarded after being brought onboard," followed by "operational discards," "other," "unknown," "partial release," and "full release."
- Fishing activity made up approximately 23% of trips, suggesting that a reduced portion of the total video could be reviewed in detail to detect discard events.

Following the completion of the data collection period, the project team compiled the data and performed a series of summaries and analyses. Initial results of this work suggest that video-based EM has potential to be an effective monitoring tool in this fishery.

- Census and audit EM reviewers agreed that approximately 41 slippage events (26 partial release and 15 full release) had occurred in addition to another estimated 88 operational discard events.
- There was a high level of agreement among EM reviewers in categorizing full release events (94%).
- For smaller release events reviewers were generally able to identify that a release event had occurred, but often did not use the same classification to describe the events. For partial release events reviewers agreed in approximately 55% of the cases. In cases of disagreement, one reviewer typically classified a discard event as a partial release and the

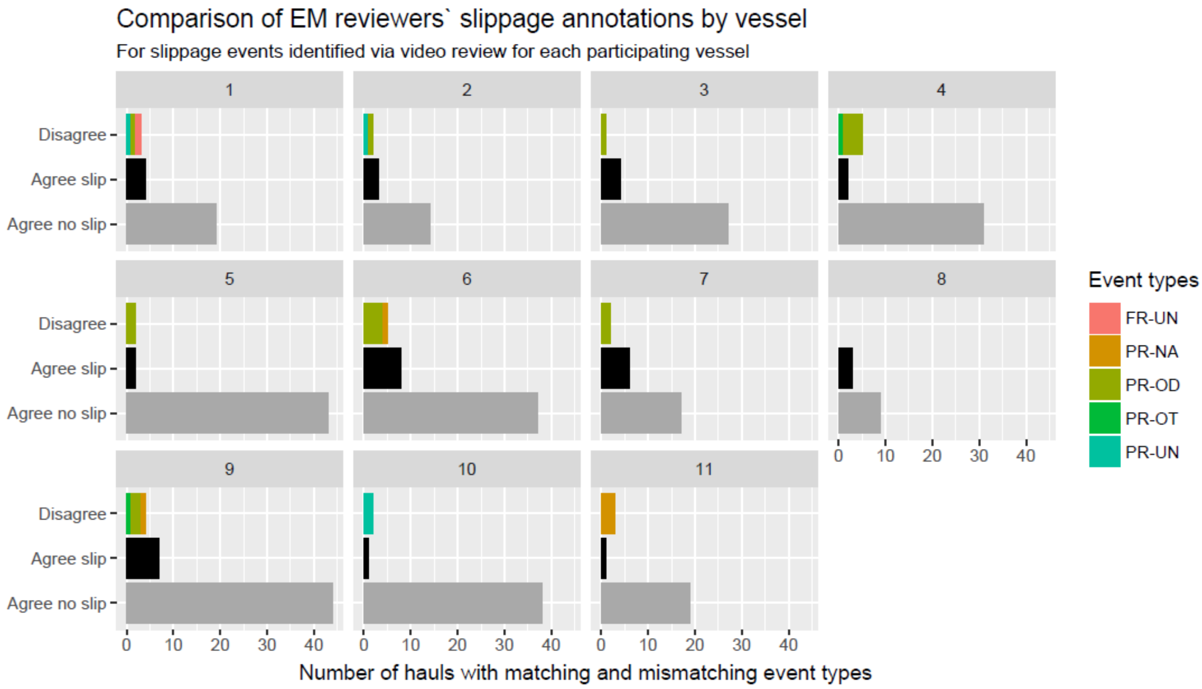
other reviewer classified the event as operational discards. The comments entered by reviewers suggested that in many of these events, reviewers were viewing similar releases of catch but categorizing them differently.

- Data comparisons between EM reviewers and NEFOP observers showed general agreement in identifying and categorizing slippage events. A close comparison of these events highlights the strengths and weaknesses of each data stream.
- Agreement between reviewers (our primary metric of performance in this study) was often impacted by factors such as the total number and placement of cameras on a vessel; factors that could be better controlled in an operational program where vessels would be expected to meet required standards and protocols regarding camera set-up (EM system set-up varied by participating vessel as participation was voluntary and vessels have different layouts).

Results

This project set out to determine if EM could be an effective tool for detecting and categorizing discard events on midwater trawl vessels and to develop a framework for EM implementation in this fishery. We determined EM could successfully detect full release events to a high degree of accuracy (94%) and likely highly effective for identifying smaller releases. It was more challenging to categorize these smaller releases as either partial releases or operational discard events. Interestingly, in cases where audit and census reviewers categorized these events differently their notes often described similar events. This leads us to believe that better definition of the two events with regards to EM, and perhaps greater standardization among reviewers, could help to eliminate these discrepancies.

In addition to comparisons of event categorization, data collected in this project assisted with the development of recommended operational considerations to maximize the effectiveness of video-based monitoring systems in this fleet. Specifically, results provide valuable information on the average times for EM video review and potential drivers of increased review time (mainly individual annotations of discard after being brought on board events). Further, our results suggest that an audit approach to video review may be sufficient, and may substantially reduce total review time, program costs, and storage requirements. Overall, EM was effective in detecting and categorizing full release slippage events when EM cameras were appropriately situated and used as recommended. Furthermore, EM was effective in detecting and categorizing catch discarded after being brought onboard. While EM was effective in the detection of discard events, reviewers had some difficulty in differentiating between operational discards and partial release slippage events consistently.



Conclusion

EM system installation varied among vessels and allowed us to evaluate the effectiveness of each unique configuration and determine the ideal camera setup to capture all discard activity in this fleet. We determined three to four cameras, capturing the four areas where discarding occurs, would be required in an operational EM program. The EM system deployed in this fishery performed well and captured high quality data throughout the project with very few system performance issues.

Two review methodologies were used to determine efficacy of quantifying and categorizing discard events in this fleet. An audit approach that focused primarily on fishing events as indicated by sensors installed on the vessel and a census approach that looked at all video captured during each trip. Preliminary results show that the audit method of review is comparable to the census review and would be a more cost effective model for implementation.

Multiple cost drivers impact the costs of full EM program implementation. Data services, which include data management, review and storage, were found to be the most significant. A key start-up cost for this program and many EM programs is the time required to decide on the data fields to be incorporated into a database and determine review protocols. In an operational EM program, it is important to ensure all of the data collected by the EM system can be compared to, and potentially integrated with, existing observer and portside monitor data streams. Data goals impact system install decisions as well as data management, review and reporting costs.

On board automatic identification and quantification of the total catch: the iObserver

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Identification and quantification of the total catch in commercial vessels is an important job that provides ship owners, scientists and/or EU regulators with highly useful data. Currently, this job is performed by human observers. However this approach has several drawbacks since human observers: cannot cover the whole fleet; need resting time; occupy room in a very limited environment; must be paid a salary, insurance; might enter in conflict with the crew, etc. A possible approach to solving these problems is the development of automatic systems able to perform the tasks of a human observer.

The aim of this work is to present the iObserver, an electronic device aiming at automatically identify the species in the catch; estimate the length of each individual; and quantify the biomass. This device works without interfering on the fishermen activity.

The data acquired by the iObserver is transmitted to the RedBox, a software that integrates such data with information provided by the vessel instrumentation (velocity, course, depth, etc.). From the RedBox, information is sent to management servers in land (**Error! Reference source not found.**) where it can be employed for different purposes such as: improving the quality and availability of data; feeding mathematical models that can be used as decision-making tools to improve fishing efficiency; or creating probability maps revealing regions with high presence of under-size fish or forbidden species, etc.

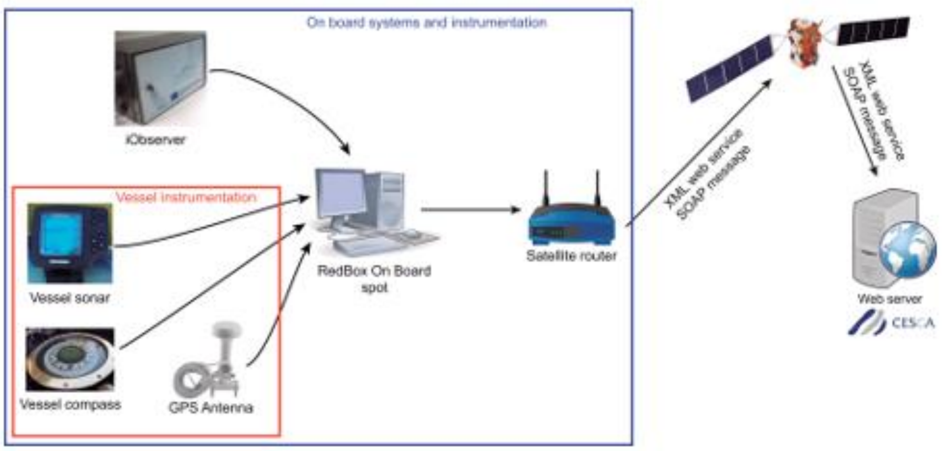

Figure 1. iObserver/vessel instrumentation data integration and transmission to the inland center

<u>The iObserver hardware</u>

The iObserver is located over the conveyor belt, just before the zone in the fishing park where fish is separated by the crew, to take pictures of the whole catch (see **Error! Reference source not found.**).

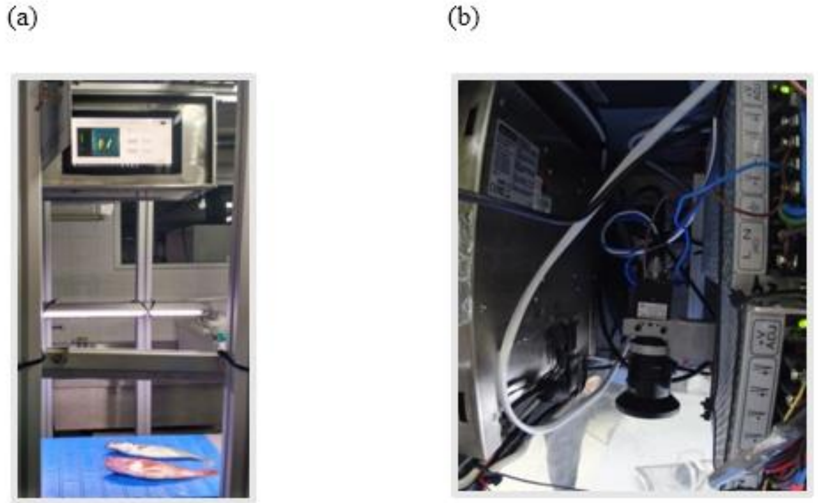

Figure 2. (a) The iObserver installed over the conveyor belt. (b) Inside view of the iObserver showing the different hardware component.

From the hardware point of view, the iObserver consists of an industrial camera and a processing unit (industrial PC) equipped with our self-developed computer vision software. A touch screen was installed to facilitate its use on-board. The hardware is protected by a steel waterproof case able to operate in harsh environments (**Error! Reference source not found.**a). Lighting is designed to provide a constant soft light rectangle on the belt. For such purpose, a pair of LED strip lights was used. Height and angle of these lights can be modified to minimize shadows and brightness variations within the picture. A Peltier cell was installed inside the box to avoid condensation problems. The whole system weights around 18 kg which makes it manageable to be installed in different vessels.

<u>The iObserver software</u>

Skin descriptors (color and texture) as well as fish shape are used to perform species recognition. The recognition software also estimates fish length which is used to compute fish weight through a given formula (Torres et al. 2012). The iObserver is operated through an intuitive graphical user interface (GUI) that requires minimal interaction with the user. Three different tasks can be performed through the GUI:

- *Calibration*. This process is mainly about: (i) finding out color characteristics of the conveyor belt; (ii) determining the lighting conditions; and (iii) establishing a relationship between pixel coordinates and real distances. If lighting conditions and camera position are constant, as it is usually the case on board commercial vessels, the calibration process may be performed just once.
- *Training*. It consists of taking several pictures of different individuals, in different positions (dorsal, ventral, lateral) of the same species. Then, by pressing a button in the GUI, the software will extract the relevant information of each fish (basically color, texture and shape) and will create a catalog with the information of all trained

species. The software is already provided with an initial catalog containing 19 species from ICES and NAFO regions.

- *Identification*. At the beginning of the haul the identification task is initiated by pressing a button in the GUI. The iObserver will take pictures of the whole catch. For every picture it will automatically: isolate all the individuals; extract the information (color, texture, shape) of each individual; and compare it with the information in the catalog created in the training task. A report (CSV format) summarizing the identification results is created.

An auxiliary system of sensors/magnets is installed to automatically trigger the signal that will take a new picture. In this way, the whole catch is captured without repetition independently of the conveyor belt velocity.

iObserver pilot tests and recognition results

The iObserver has been tested both in land and at sea. In land tests, easier to carry out, allowed us to identify a number of problems and to provide an estimate of the identification accuracy. To that purpose different tests, in which fish was manually classified and measured, were carried out. Then, iObserver identification results were compared against manual classification data. If individuals are not overlapped accuracy is above 90%. Mean error in size estimation is below 3%. When fish is overlapped accuracy is still low (below 40%). However, we believe that these results can be further improved when overlapping between individuals is lower than 50%.

Tests on board oceanographic and commercial vessels were carried out after the in land essays. Oceanographic vessels, much bigger and flexible than commercial vessels, were firstly used. 10 surveys in the regions ICES-Spain; ICES-West Ireland; and NAFO, were performed with a total number of 270 days at sea. The iObserver was used in 780 hauls and taking around 170,000 pictures. After these preliminary trials, the iObserver was also tested on board commercial vessels (two boats from the OPROMAR fleet). Eight surveys (with a total number of 36 days at sea) were carried out so far in ICES-Spain region. In these surveys the iObserver was used in 128 hauls taking around 29,000 pictures.

This prototype is still under development. In this regard, alternatives to improve the lightning system are being explored. On the other hand, use of vessel instrumentation data to automatically estimate the start and the end of hauls will be implemented. This will allow the iObserver to work in a complete automatic way. Finally, different procedures, such as machine learning or techniques based on singular value decomposition, are under study to improve fish segmentation and recognition with overlapped individuals.

References:

Torres, M.A., Ramos, F., Sobrino, I. (2012). Length-weight relationships of 76 fish species from the Gulf of Cadiz (SW Spain), *Fisheries Research*, 127-128, 171-175.

Advances in the automated detection and recording of capture events from on-vessel video footage

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Introduction

Sustainable fishing is both a mandated objective of modern fishery regulators and an expectation of our communities. Observer programs have traditionally been used to monitor the targeted catch, and species that are accidentally caught (bycatch). Increasingly, on-board cameras (e-monitoring) are replacing human observers on vessels. Hours and hours of recordings are then manually viewed in the office by analysts. This is expensive and inefficient, and even though 100% of a fishing trip is recorded, typically 10% of the footage is actually examined. Our solution to this problem is rapid event detection and species identification with automated video analysis for the electronic monitoring of fisheries operations. The solution has been developed for longline fishing, but it can be extended for other gears.

Overview

Wanda is our prototype software developed for fishing event detection and fish species identification from video footage acquired by electronic monitoring (EM) systems installed on longline fishing vessels. The software includes two modules (i) for fish detection within a video frame and tracking of the fish over time sequenced video frames, and (ii) for fish species classification. A post-processing module then performs temporal integration and splits the video footage into different fishing events. It then conducts targeted analyses for each integrated fishing event. This is used to process EM videos to automatically log each event, including their species, and count the total catch of each species. The core technologies we use in the software include image processing, artificial intelligence (AI) and event detection. The software modules can be adapted to other applications for automated catch monitoring.

Methods

We have employed a machine learning model to serve as a fish detector and a different model for fish species classification. Specifically, we have adapted a Deep Neural Network (DNN) to serve as a fish detector and isolator, re-configured a pre-trained pure Convolutional Neural Network (CNN) as a species identifier, and designed a post-processing module for the temporal integration and analysis of fishing events. We have developed Domain Adaptation techniques to increase the usability of variably sourced data to further re-train the resultant network following transfer learning.

Detection, Localization and Isolation

The detection, localization and isolation of fish-like objects are performed by our Detection Module (DM). The DM inherits TB’s basic architecture – a CNN (GoogLeNet) for extracting and encoding the image features and a Recurrent Neural Network (RNN) to ultimately accomplish the localization task. However, our DM produces one prediction for each video frame, rather than the multiple predictive bounding boxes that TB generates.

Classification

Our Classification Module (CM) is based on GoogLeNet [1]. The original GoogLeNet is a large network. The asymmetrically small size of our available training data initially resulted in parameter overfitting. We remedied this with significant model reduction. Transfer learning [2] was used to take advantage of a CNN pre-trained on more readily available data. We have developed Domain Adaptation techniques for use in combination with transfer learning to increase the usability of variably sourced data to further re-train the resultant network.

Fishing Event Analysis

Video frames are integrated into fishing events for fish classification and fate analysis. We have designed several techniques for this, including analysing the continuity of the frames in which fish are detected. By tracking individual fish movement, we split an EM video footage into different fishing events.

Results

As shown in Figure 1, the analytical results can be displayed on the front end of Wanda, which is a Graphical User Interface incorporating some additional functions useful for preparing a fishing trip report.

Figure 1. Analytical results can be displayed on the Graphical User Interface of Wanda

Conclusions and Future Work

We will further develop Wanda to include more species from different fisheries, and expand the software functions for trawl and gillnet fishing.

References

[1] C. Szegedy, W. Liu, Y. Jia, P. Sermanet, S. Reed, D. Anguelov, D. Erhan, V. Vanhoucke and A. Rabinovich, "Going deeper with convolutions," 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Boston, MA, 2015, pp. 1-9. 2015.
[2] S. J. Pan and Q. Yang, "A Survey on Transfer Learning," in IEEE Transactions on Knowledge and Data Engineering, vol. 22, no. 10, pp. 1345-1359.

Responsive Observer Deployment Solutions for Northeast United States Fisheries

Heidi K. Marotta, Nathan Clark, Andrew Jones, Charles Keith, Thomas Liebert, Holly McBride, Michael Palmer

NOAA Fisheries, USA

The deployment of at-sea observers in the Northeast United States (US) groundfish fishery is accomplished using a web-based system, the Pre-Trip Notification System (PTNS). The National Marine Fisheries Service, the US regulatory agency that oversees at-sea sampling in federally managed fisheries, is in the process of making large-scale improvements to the PTNS. There are several motivations for improving this system, with the most critical being the need for greater flexibility. This need is driven by demands to support multiple fisheries with different sampling requirements (i.e., sampling design and collection protocols). The traditional existing horizontal database design with a predetermined structure was abandoned due to the costly and time consuming database and application modifications that were previously necessary to keep pace with regulatory changes. PTNS has now been implemented with a vertical database design, making the database quickly and easily extendable, and enabling the system to be rapidly reconfigured to keep better pace with the needs of fisheries managers. System changes that would previously require months of recoding and testing can now be accomplished in hours.

The sampling design (e.g., stratification parameters) are now stored as database content. Trip selection methods can vary (e.g., random weighed probability and individual vessel comparison) and be applied according to the specific observer needs of a fishery or the sampling requirements of individual sampling programs within a fishery (Figure 1). Trip notification is also stored in vertical database structures which allows for maximum flexibility based on the fishery (Figure 2, Figure 3). By removing code from the application and instead placing content in the database allows for dynamic coding to match the declared trips to the stratifications. Dynamic logic in the application layer and vertical database design that can be quickly reconfigured through updates to database content is now a long term solution that can be reactive to regulation changes and the challenging caveats that arise to accommodate the commercial fishing industry.

Ultimately the complexity of the Northwest Atlantic regional fisheries warranted a seamless system that can satisfy deployment of observer coverage. As fisheries management around the world becomes increasingly complex, closer monitoring and deployment of observers is critical to the sustainability of the fisheries. PTNS is a new suite of tools to be used by vessels, observer service providers and fishery managers that can be easily adapted to other regions throughout the world by interacting with the database content to reflect each region's specific requirements.

PK	FISHING YEAR	SAMPLING PROGRAM	OPERATION METHOD
1001	2018	SBRM	SEA DAY ALLOCATION

PK	GROUP	COVERAGE RATE	INDIVIDUAL VESSEL COVERAGE THRESHOLD	INDIVIDUAL VESSEL MINIMUM TRIP COUNT	PROVIDER SELECTION TYPE	COVERAGE TYPE
1001	1013	0.05	0.02	10	RWP	NEFOP

PK	GROUP	CONTROL FIELD	CONTROL VALUE
1001	1013	ACCESS_AREA	OPEN
1001	1013	EFP_PROGRAM_ID	0
1001	1013	EFP_PROGRAM_ID	3
1001	1013	EFP_PROGRAM_ID	5
1001	1013	GEAR_MESH	092-LM
1001	1013	PORT_REGION	NE
1001	1013	TRIP_PERMIT_CATEGORY	ALL

Figure 1. Subset example of the types of stratification configuration parameters and the vertical representation of the sampling design.

CONTROL FIELD	DISPLAY NAME	ORDER	LOOKUP TABLE	MANDATORY INQUIRY	CONTROL TYPE	DATA TYPE	REQUIRED
VESSEL_PERMIT_NUM	Permit Number	2	VESSELS	1	SELECT	NUMBER	1
SAIL_DATE	Sail Date	3		1	DATE	DATE	1
FMP	Fishery	4	VESSEL_FMP	1	SELECT	VARCHAR2	1
SAIL_PORT	Port Sail	5	PORTS	1	SELECT	VARCHAR2	1
EST_TRIP_DURATION	Estimated Trip Duration (Days)	6	ESTIMATED_TRIP_DURATION	1	SELECT	NUMBER	1
GEAR_MESH	Gear/Mesh Size	7	FMP_GEAR_MESH	0	SELECT	VARCHAR2	1
PERMIT_CATEGORY	Permit Category	8	VESSEL_FMP_CAT	0	SELECT	VARCHAR2	1
TRIP_PERMIT_CATEGORY	Trip Permit Category	9	VESSEL_FMP_TRIP_CAT	0	SELECT	VARCHAR2	1
ACCESS_AREA	Access Area	10	ACCESS_AREAS	0	SELECT	VARCHAR2	1
FISHING_REGION	Fishing Region	11	FISHING_REGIONS	0	SELECT	VARCHAR2	1
PORT_REGION	Port Region	12	PORTS	0	HIDDEN	VARCHAR2	1
SECTOR	Sector	13	VESSELS	0	HIDDEN	NUMBER	1
EFP_PROGRAM_ID	EFP Program	14	VESSEL_EFP	0	SELECT	VARCHAR2	1

Figure 2. Subset of control field definitions used to draw the user interface web pages.

ID	SAMPLING PROGRAM	REGION	GEAR_MESH	ACCESS_AREA	TRIP CATEGORY	SECTOR	FISHING_REGION	EFP_PROGRAM
NUMBER	VARCHAR2	VARCHAR2	VARCHAR2	VARCHAR2	VARCHAR2	NUMBER	VARCHAR2	VARCHAR2
1	SBRM	NE	092-LM	OPEN	ALL	[NULL]	[NULL]	[NULL]
2	ASM	[NULL]	204-ELM	[NULL]	[NULL]	3	BSA2	5

ID	SAMPLING PROGRAM	FIELD	VALUE
1	SBRM	REGION	NE
1	SBRM	GEAR_MESH	092-LM
1	SBRM	ACCESS_AREA	OPEN
1	SBRM	TRIP_CATEGORY	ALL
2	ASM	GEAR_MESH	204-ELM
2	ASM	SECTOR	3
2	ASM	FISHING REGION	BSA1
2	ASM	EFP_PROGRAM	5

Figure 3. Example of trip notification transformed from traditional horizontal to new vertical design.

Abstracts of presentations that did not provide Extended Abstracts

Accelerating the Development of Automated EM Video Review through Competitions

Christopher McGuire, Benjamin Woodward, Kate Wing, Matt Merrifield

The Nature Conservancy

Automating Electronic Monitoring (EM) video review has the potential to revolutionize the fishery monitoring process; driving down costs, increasing coverage rates, and reducing the burden on human observers and video reviewers. One way to access data science and machine learning expertise, that might be otherwise cost-prohibitive, is through online open data competitions. Here we describe our experience using two data competition sites, Kaggle and DrivenData, to develop algorithms for automated EM. In 2017, our teams used EM video to create training data sets for the New England groundfish and Western Pacific tuna fisheries, and partnered with these data platforms to run first two known competitions focused on EM video review. Each resulted in first generation open source algorithms to identify, count, and measure fish that are publicly available. This presentation is intended to spark a discussion of current and future applications of machine learning tools in the EM process.

In-country capacity building and infrastructure development, the human component of electronic monitoring programs

Craig Heberer, Kydd Pollock

The Nature Conservancy

While advances in electronic monitoring hardware and software development have driven costs down and increased efficiency, the focus on in-country human capacity building and infrastructure development has lagged significantly behind. In order to take electronic monitoring to scale on a regional basis, more attention will need to be paid to this critical social component. The Nature Conservancy's Indo-Pacific Tuna Program is working collaboratively with industry and country partners in Palau, the Federated States of Micronesia, the Republic of Marshall Islands, and the Solomon Islands on a 25-vessel tuna longline electronic monitoring project with a focus, among other things, on these social objectives. This presentation will highlight lessons learned to date and provide some insights and recommendations on the future of EM monitoring programs from a human capital point of view.

Looking for trouble: protected species in the Common Fisheries Policy

Bram Couperus

Wageningen University - Marine Research

Since 2017 the monitoring of protected species in the European Union is implemented in the Data Collection Framework (DCF). Before 2017 the framework only focused on sampling of landings and discards of (commercial) fish species. The implementation of the new DCF has major implications for the existing sea going observer programmes on board fishing vessels. There are more than 200 protected species that need to be monitored. The likelihood of bycatch for all of them is low, resulting is data sets with a lot of zeroes. This means that designs and sampling protocols of existing observers schemes require adaptation. Also observers have to face new challenges, such as altered attitudes of crews towards them.

This poster describes the new DCF and what kind of challenges, on a scientific and on a management level, it will pose in its practice implementation.

EM evolution: where do we come from, where are we headed

Helena Delgado

Satlink

Gathering information from activities at sea has always been challenging. For decades improvements in communication and information gathering have been made with two main focuses: fishers safety and fishing activities information. Electronic Monitoring (EM) has brought traceability, transparency and effective management with irrefutable data. Furthermore, EM is fighting the low observer coverage and lack of verifiable data as well as overcoming new challenges such as monitoring human conditions on board. The near future not only holds technological advances to enhance EM performance and video analysis speed (i.e. machine learning – already being tested). For a successful future, these modern advances must be combined with: cross-sectorial collaboration, education, work cycle (all parties involved know their duties and non-collaboration consequences, and communication (sharing what was learnt). These are the keys for success. With this poster we want to share our experience after many years working in the field worldwide. We have looked back and learned from it, we have analysed the present and thought about what is needed in the future.

The poster presented will guide the reader through the past, present and future of the history of managing our fisheries. We are planning to make an interactive poster to bring more interest, action and conversation to the poster sessions. We believe this topic will be a great conversation topic as this is always conversation material in all meetings and fisheries gathering all over the world.

Workshop 1 - European Union Landing Obligation

Leaders: Lisa Borges and Jørgen Dalskov

Introduction

The European Union introduced a landing obligation for all EU fishing vessels from the 1st January 2015, to be implemented progressively by species and fisheries until 2019. As fisheries' activities change to this new management regime where discarding is prohibited, the main question of the workshop was: how have at-sea monitoring programs adapted or changed because of it?

The workshop objectives were to shared experiences among countries and regions where similar policies have been implemented, identifying common challenges and issue while at the same time identifying best practices and providing recommendations. The specific workshop goals were to:

- Build a shared understanding of the current state of EU observers programmes
- Discuss using cases to identify successes and challenges of the LO in observers programmes
- Gain a better understanding of the issues observers programmes face under a discard ban policy
- Expand networks among participants

The workshop focused on the impact of discard bans (also known as full catch retention policies), on at-sea monitoring programmes, in four different themes, with two questions each, as follow:

Theme 1 - the issue of observing for science but being seen as observing for compliance;

Question 1.1 – are observers/EM seen by fishers as compliance in a discard ban?

Question 1.2 – what are the issues of scientific monitoring vs compliance monitoring?

Solution – What are the solutions?

Theme 2 - the lack of, and/or bias of, the data collected;

Question 2.1 – what is the effect of a discard ban on data collected on board?

Question 2.2 – do fishers change behaviour when observer/EM on board?

Solution – how can these effects on data be minimised?

Theme 3 - the quality of catch and landing statistics;

Question 3.1 – has a discard ban affected other sampling programmes?
Question 3.2 – is data from at-sea monitoring used for catch data quality control?
Solution – can a checklist be developed?

Theme 4 - the reliability and accuracy of scientific advice.

Question 4.1 – what is the effect of a discard ban on the uncertainty of stock assessments?
Question 4.2 – what is the effect of a discard ban on scientific advice and on how it is presented?
Solution – What are the solutions?

<u>Results and Discussion</u>

The workshop had 52 participants from all areas of fisheries science, management and compliance, from observers and observer program managers, EM providers and users, to fisheries managers, fishers, control officers and NGOs. Participants were divided in four concurrent sub-groups where each theme and respective questions were discussed for approximately one hour. After two themes, a brief presentation on the two most important points discussed was presented by the chair or rapporteur of each of the following sub-groups:

- Group GREEN - Chair - Marie Storr-Paulsen; Rapporteur - Teresa Athayde
- Group YELLOW - Chair - Lee Benaka; Rapporteur - Helen McCormick
- Group BLUE - Chair - Helen McLachlan; Rapporteur - Rodrigo Vega/Helena Delgado-Nordmann
- Group ORANGE - Chair - Jose Rodriguez Gutierrez; Rapporteur - Vanessa Tuttle

Theme 1 - the issue of observing for science but being seen as observing for compliance

Question 1.1 – are observers/EM seen by fishers as compliance in a discard ban?
Question 1.2 – what are the issues of scientific monitoring vs compliance monitoring?

The groups agreed that observers/EM are indeed seen by fishers as compliance in a discard ban. It was discussed that historically there was very little fisheries control in Europe, and over the last 20 years fisheries are evolving into a new era with much higher levels of control, with logbooks, VMS, electronic reporting, EM. The introduction of the LO is a new challenge, and is essentially adding another layer of control.

In the EU waters there are mainly scientific at-sea monitoring programs that do not impose observer deployments to vessels by fear of collecting biased data. Yet, there is a mandate in fisheries legislation that could oblige vessels to take observers. The groups noted that some fisheries have and will continue to refuse to carry scientific observers on board, but were unsure if this was an indication of non-compliance within those fisheries. It was also noted that in worst cases, observers may be viewed as spies for other boats. In the EU, fishers responses to observers request to go on board are now being logged in order to be able to calculate refusal rates that can be used as a data quality indicator. Preliminary data show that some refusals are due to the LO, but these results can also be confounded by other historic issues such as quota management, closed areas, mistrust of scientists and miss-use of data. Lack of space for observers on smaller vessels can be a physical obstacle, while the cost of carrying an observer can be substantial for a small boat. However, observer associated costs can be covered by a tax on landings, as it is the case in the US and Norway.

There are many examples throughout the world of fisheries operating under discard bans: from Argentina where observers have access to high seas vessel but not small artisanal vessels, to the US where some fisheries have 100% observer coverage, to Norway where there is no observers programme while enforcement is done by coast guard boarding's and fines.

It was also agreed that scientific monitoring is done for a purpose, e.g. stock assessment and monitoring fishing activity, whereas compliance monitoring is done for control, to build up evidence. However, there are areas of scientific monitoring that could be used for compliance. EM could be used as a method of verifying scientific monitoring programmes, but at the same time verify that the vessel is doing what it is supposed to be doing. EM can therefore be used for science and for compliance purposes, as its role is to observe. Finally the groups agreed that fishers are probably more willing to work with scientific observers than control observers.

Solution – What are the solutions?
All groups agreed that improving communication is needed, that scientific programmes should feedback to skippers on positive aspects but also where the problems are and possible alternatives. Some groups identified more monitoring, control and fines as another solution, while others mentioned policy support to deal with refusal rates.

Theme 2 - the lack of, and/or bias of, the data collected;

Question 2.1 – what is the effect of a discard ban on data collected on board?
Question 2.2 – do fishers change behaviour when observer/EM on board?

The effect of a discard ban on data collected at sea depends on the fishery. For example, data has improved in the Dutch pelagic fishery since the LO come into force, and has led to a change in the fishing behaviour: when catching an unwanted species composition skippers will move fishing grounds. However, with the LO there is a more complicated procedure for sampling catch, as before catch was divided between landings and discards, while now there is the portion of catch below minimum size (BMS), and vessels may treat this portion of the catch differently. There is also the added difficulty of dealing with legal discards and discards under LO exemptions.

As the date for full LO implementation approaches (January 2019) the challenge to collect discard data will increase and refusal rates to carry observers on board are likely to increase. The risk of non-representative data will probably also increase as the vessels that will bring out observers are those with a higher level of compliance. This may also have a negative effect on other countries, such as Norway, that rely on similar EU fisheries for their discards estimates as they do not sample discards.

All groups agreed that generally fishers do change behaviour when observer/EM is on board, but this difference in behaviour can be positive or negative. Fishers can change their typical fishing behaviour by, for example, moving or avoiding fishing grounds to reduce discards, and this may cause bias in the data. Nevertheless, some groups noted that there are more significant changes in fishers behaviour with observers on board than with cameras.

Solution – how can these effects on data be minimised?
Some groups referred that certified fisheries (MSC certified) have caused considerable changes in fishing methods and practices and in the mindset of fishers, and thus that environmental certification could be a way forward providing benefits for all stakeholders. But there is still a need to drive a more civic based fishing society for good practices and good communication. The potential for self-sampling as a method for gaining data from non-observed vessels was also highlighted. Others mentioned time series data analysis to look for shifts pre and post LO as a solution, as well as regular bias assessment of observed versus unobserved trips. The need for more control and increase observers coverage was also identified by all discussion groups. And finally, implementation of fully documented fisheries (EM) would improve the possibilities for minimising bias in data, while the use of at-sea monitoring data for different purposes and users (scientific, control, fishers, NGOs) could lower its costs.

Theme 3 - the quality of catch and landing statistics;
Question 3.1 – has a discard ban affected other sampling programmes?
Question 3.2 – is data from at-sea monitoring used for catch data quality control?

In some countries, such as Sweden, Ireland and Norway, there was a decrease in port sampling (also known as dockside monitoring) due to denied access, but this negative impact on access to the landed fraction of the catch is not a new issue, and other reasons including misuse of data, mistrust of stock assessments and quota issues were also mentioned. Refusals to sampling are also extending to processing plants and auction halls and to other sampling programmes (ex. seabirds). Furthermore, for Protected, Endangered or Threatened (PET) species sampling, lack of access to vessels means a decrease in fleets coverage, and they may even reach 100% refusals in some fisheries. In Chile, bias between observed and industry self-sampling has been observed. Finally, it was discussed that observer's jobs will be affected when the LO is implemented particularly in dockside sampling, as the non-marketable catch brought back will have to be sampled, and this could be a new and difficult challenge to overcome.

Several countries such as Sweden, Spain, Chile and Canada use data from at-sea monitoring for catch data quality control, from logbooks to reference fleets. However, some groups discussed that if levels of sampling from at-sea monitoring programmes are very low, as it is in the case of most EU fleets (1%), then any meaningful data comparison is not possible. But if coverage was increased or supplemented with EM, data from at-sea monitoring could be used for catch data quality control. In Canada, 100% at-sea monitoring coverage has been viewed very positively by the industry, as it allows fishers to fish the way they wanted, and not being forced to fish in the limit of legality by peer pressure. The challenge identified is how to implement EM in the context of the EU, with high number of vessels producing high volumes of data. In Denmark, for example university students are paid to look at discard data and video footage, while in Argentina video analysis is a part of the career development of on board observers. Nevertheless, the possible bias in the data was identified as a more important issue, so correcting or minimising the bias should be a priority. Finally, the groups agreed that the "last haul" data from fisheries control authorities could provide additional data, noting that the LO is not being fully controlled and not all MS have yet to implemented the LO.

Solution – can a checklist be developed?
A higher quality of catch and landing statistics could be achieved by increasing, at EU level, coverage of at-sea monitoring programmes to attain a representative coverage, namely by increasing observers coverage although some groups identified EM as a possible solution. More fishery independent surveys were also identified as a solution for biased fishery data but at a significant cost. Other groups suggested the use of quotas to incentivise compliance, by subtracting discards from quotas and providing additional quota to vessels that can prove they comply with discard restrictions. Monitoring and compare estimations from observers data with logbooks was also emphasized. The need for sharing scientific data with fishers was again identified, so that they are incentivized to participate in the process. And finally, data confidentiality is an issue that needs to be addressed, as to reassure vessels that raw data would not be shared or published.

Theme 4 - the reliability and accuracy of scientific advice.
Question 4.1 – what is the effect of a discard ban on the uncertainty of stock assessments?
Question 4.2 – what is the effect of a discard ban on scientific advice and on how it is presented?

The groups identified several possible ways how the LO may be increasing stock assessment uncertainty. By creating confusion with the new catch fraction sampled: BMS (Below Minimum Size) landings. Boats that are accepting observers are also probably complying with the fishing rules, which is creating bias in the data as the collected data does not reflect the fishery and therefore increases bias in stock assessments. Furthermore, until now the LO has had no real impact as it has not really been enforced, while countries have had quota uplift but are essentially still discarding. There is also uncertainty around assessments of other species such as seabirds, and a group wondered what the implications may be, namely that the discard ban may lead to a decrease in certain seabird populations. On the other hand, some were of the opinion that the increased importance of improved discard mortality rates could lead to additional research and therefore less uncertainty in stock assessments.

The groups agreed that the LO is creating confusion in scientific advice as it is causing scientific advice to become political when it should not be. Scientific advice is now, to some extent, being entangled in control issues, but will improve once the discard ban is enforced.

Solution – What are the solutions?
Some groups suggest increased observer coverage as a solution, but also better documentation of catches. More research on survivability of discarded fish was also identified as a possible solution, even for species with already established high survival, as survival depends on fishing practices at the time of capture and discard. Stock assessments should include more information regarding the uncertainty of the models used. Other groups felt that a solution would be to create incentives to fish more efficiently, while others thought that the entire supply chain should operate under the conditionality's of the LO, not just fishers. And finally, that proper monitoring and control is essential to enforce the LO,

and that the cost of the necessary increase in at-sea monitoring could be paid by quotas adjustments (top-ups) and by the European Maritime Fisheries Funds (EMFF).

Conclusions and Recommendations

A series of questions were posed to the participants in the beginning and end of the workshop to seek information on participants knowledge and if that changed trough the workshop, via immediate responses using the on an online Kahoot quiz. Because of Wi-Fi capability, however, most responses came from European delegates with free 4G access. The questions and responses were:

What is your background?	
Scientist/observer	55%
Manager/control	11%
NGO	17%
Industry	17%

Should the scientific monitoring be used for?	Beginning %	End %
Solely science	70	68
Compliance	-	2
Both	30	30

Is the LO biasing observers data?	Beginning %	End %
Yes, fishers changed behaviour	44	44
Yes, higher refusal rates	22	30
No, nothing has changed yet	30	26
No, there will be 100% compliance	2	-

Is the LO diminishing data availability?	Beginning %	End %
Yes, denied access to vessels	33	45
Yes, denied access to ports	5	3
Yes, logbook data deterioration	29	23
No, more data is available	33	29

Is the LO affecting scientific advice?	Beginning %	End %
Yes, by increasing uncertainty	43	50
Yes, by producing biased advice	32	31
No, not on stock development	14	8
No, impact is insignificant	11	11

The general conclusions from the workshop were that:

- ✓ Observers/Electronic Monitoring at-sea monitoring programmes are seen by fishers as compliance in a discard ban regime, and fishers generally change behaviour when an observer/EM is on board.
- ✓ Improving communication between at-sea monitoring programmes actors is needed to increase trust, and in particular, scientific programmes should feedback to vessels sampled.
- ✓ A discard ban can have a significant impact on all catch sampling programmes, while catch data quality can deteriorate.

- ✓ There is unwillingness by fishers to take scientific at-sea observer on board.
- ✓ The EU Landing Obligation has not yet been implemented and, as such, its effect has been marginal. Nevertheless, some positive and negative effects on at-sea monitoring programmes were identified.
- ✓ Solutions to possible negative effects of a discard ban on at-sea programmes ranged from:
  - increase sampling coverage
  - better communication between stakeholders
  - introducing other/new sampling technologies (ex. EM)
  - positive incentives, such as preferential quota location, to increase compliance
  - environmental certification
- ✓ The use of at-sea monitoring data for different purposes and users (scientific, control, fishers, NGOs) could lower its costs
- ✓ Landings taxes, quotas adjustments (top-ups) and the European Maritime Fisheries Funds (EMFF) could all be used to pay for the cost related to the necessary increase in at-sea programmes.

In summary, increasing at-sea monitoring programmes at EU level, and observers coverage in particular, is key to maintain catch data quality and associated scientific advice. Associated to this, the implementation of Electronic Monitoring systems at EU level will allow effective implementation, and ultimately enhance the achievement of the objectives, of the Landing Obligation.

Workshop 2 - Electronic Monitoring

Leaders: Howard McElderry, Brett Alger, Lisa Peterson, Courtney Paiva, Jennifer Mondragon and Gabriel Gomez

Workshop Facilitator: Kate Wing

Introduction

Electronic Monitoring (EM) refers to an integrated array of sensors, usually including still or video imagery, deployed on fishing vessels for the purposes of providing independent, verifiable fisheries information. There is growing interest to deploy EM technologies in commercial fisheries where its efficacy, operational feasibility, and cost effectiveness can be demonstrated. There are few operational monitoring programs and EM is relatively new as practitioners are gaining experience with how best to implement EM for fisheries science and management. Unlike human-based monitoring, EM has more technological and operational complexity, as well as stronger dependencies on various stakeholders. Moreover, technology is advancing rapidly and there are diverse views on what direction, and how quickly, EM will advance.

EM technologies have been a consistent conference theme for IFOMC since 2004 but presented mostly as plenary sessions. The organizers for this conference decided to include an EM workshop session in addition to the dedicated plenary session on operationalizing EM. Indeed, EM was a frequent topic of discussion in many of the plenary sessions although the workshop was structured to facilitate more focused small group discussions, guided by challenge topics provided by workshop facilitators. Attendance at the workshop involved about 140 conference delegates from 27 countries. The workshop involved two discussion sessions held over a six-hour period. Each session included brief introduction to the topic, small group discussion, and summary remarks by delegates to the larger group. Workshop objectives were:

- Build a shared understanding of the current state of EM technology
- Discuss use cases to identify successes and challenges of EM technology
- Expand networks among participants
- Help participants visualize use cases for EM in the fisheries they work with
- Help participants gain a better understanding of the functional elements of an EM program

Session 1 - “EM Basics”

The first session was aimed at exploring the specific capabilities of EM to solve current monitoring issues. Delegates were seated in tables of nine, with each table mixed by area of expertise, geography, and type of fishery. To facilitate discussions, there were three brief presentations:

- Brett Alger (US) – Current State of EM Technology in US Programs
- Dave Colpo (US) – West Coast/Alaska EM Programs-Successes and Failures
- Jon Ruiz (Spain) –Successes and Failures with Tuna Fisheries

Delegates were provided with four challenge questions to facilitate table discussion. A representative from each table then reported back to the broader workshop at the conclusion of Session 1. The challenge questions and a summary of the small group discussion follows.

Challenge Question 1. How do you see EM being used in your fisheries?

The groups agreed EM could be a useful tool for getting estimates of fisheries catch, discards, protected species, fishing effort, and catch accounting, depending on the fishery. For example, EM could probably be used for catch accounting for fisheries where the catch is coming up one-by-one, but it would be more difficult for high volume fisheries. However, EM in those high-volume fisheries could probably be used for bycatch and discards. EM could also be used for other forms of compliance, such as making sure fishermen are doing what they said they would, that they are fishing in a legal location, and are accurately self-reporting data. No matter which fishery EM was used for and for whatever purpose, it could also allow observers to have time to collect additional data or perform tasks that may be more complicated. It could also allow for additional data to be captured by the EM system, such as environmental data (e.g., meteorological, hydrography, hydro acoustic data, etc.). A potentially beneficial use of EM for the fishermen themselves would be for marketing purposes, it could be a way to catch provenance, demonstrate sustainability and support product traceability. In general, the group agreed EM needs to be thought about step-by-step, especially as the technology and costs change.

Challenge Question 2. What type of management and science objectives do you have where you see EM being useful?

What type of management science objectives do you have where you see EM being useful? The group could see EM being most useful for compliance requirements, checking discrepancies between data streams, and better traceability. EM could also be used for collecting new data streams, complementing observer data, and improving safety for both observers and for captains to see what their employees are doing. EM could also be used to expand monitoring coverage without having to physically add observers to the program. The group also discussed the need for the monitoring objectives to also address industry objectives for monitoring, such as those that improve safety and promote operational efficiencies. These initiatives help to incentivize EM for the industry.

Challenge Question 3. What questions do you have about how EM could or couldn’t work in your fisheries?

The most common questions were related to the data that EM collects. How do we use it? How do we review it? Can fishermen review data in real-time? The group also discussed how it would be interesting to see how observer attitudes change after EM implementation. The group also touched on more broad questions, such as, what is the relationship between the industry, the service providers, and the government? Or, where is the technology headed and how fast is it getting there?

Challenge Question 4. What are the challenges? Are there possible improvements (efficiency, logistical, cost)?
The discussion on challenges was the most expansive, but each table's feedback tended to fall in one of five categories:

1. Perceptions and incentives for EM was discussed the most;
2. Fishermen privacy and security, and their perception that EM was a form of 'big brother', all challenge the participation of vessels in EM programs;
3. The group agreed that a major trial to EM was that you were trying to manage people, not fish. A champion of the technology needs to be found who can build the trust needed for buy-in;
4. Challenges related to costs was also common, such as determining who is and who should be paying for; and
5. EM. Standards for EM was brought up frequently, including data management standards, privacy and security, how to deal with the constant changing of technology, and evaluating service providers.

Other challenges focused on the technology itself and that there are differences between fisheries that make it harder to identify general benefits that apply to all fishermen.

<u>Session 2 - "Putting EM to Work"</u>
The second session was aimed at exploring some of the broader issues with EM, moving from the specific capabilities of the technology to practical issues of monitoring at scale. To facilitate discussions, there were two brief presentations:

- Jennifer Mondragon (US) – Implementation Experiences in Alaska
- Shawn Stebbins (Canada) – EM Implementation Experiences with BC Groundfish Fisheries.

Unlike seating arrangements in the first session, delegates self sorted into seven groups to align with discussion topics nominated by the delegates. The topics are identified below, along with rational for their importance. No attempt was made to capture the discussion from these small group sessions as the main objective of this activity was to get delegates exchanging with those of similar interests.

Topic 1. Landings Obligation
The EU will soon be implementing regulations that will prohibit discarding and require all catches of quota species to landed and documented. Many see EM as the only tool available to successfully enforce these new catch retention regulations, yet there are many challenges to apply this methodology across such a large fleet and geographic expanse. Further, there is a general lack of support for monitoring among fishing groups that to date have experienced little or no monitoring. Many of the workshop participants were

specifically interested in learning more about EM to better understand its efficacy to enforce these new discard prohibitions.

Topic 2. Data Sharing

EM creates unique data challenges. Raw sensor and image data files are very large, and it is difficult or costly to transfer data from vessel to analysis location without physically shipping hard drives. Vessels hosting EM systems have concerns that the data created may be used for purposes far broader than the original monitoring objectives, hence ownership, rights of access, and clarity on the permitted uses of the data are important stakeholder concerns. Meanwhile, regulators are charged with responsibilities and associated costs of meeting their legislated data requirements which include protection of privacy and data archiving.

Topic 3. Trawl and Bottomfish

Demersal fisheries often have mixed species catches, only some of which may be of commercial value. Catch quantification is often an important monitoring objective, keeping track of species composition and catch disposition (retained or discarded). Demersal fisheries with mobile gear such as trawl create unique challenges with the entire catch contents presented on deck in a single instance, as opposed to fixed gear where catch general comes aboard in singular fashion. Independent monitoring is increasing in demersal fisheries and the work from many existing EM programs is translatable to these new monitoring challenges.

Topic 4. Incentives and Collaboration

Successful deployment of EM requires well-organized programs where the data needs of the regulators are aligned with the logistical needs of the fishing vessels. Multi-stakeholder workgroups have been very effective in the design and development of new EM programs. Moreover, EM programs generally benefit from the support and cooperation of all stakeholder groups any many programs start with some sort of incentive structure to encourage participation. Finding ways to encourage support, or at the very least acceptance of EM, is essential.

Topic 5. Tuna Fisheries

The world's tuna fisheries present some very unique challenges for independent monitoring. Among seine fleets observer programs are well established and there is increased interest in use of EM to augment observers, and in some cases replace observers where it is impractical for their deployment. Among surface longline fisheries regulators are very interested in EM because of the difficulty achieving current coverage targets on such a vast fleet that operates across such a broad geographic range. As well, the extended duration at sea and difficult working conditions make it challenging for observers. Coupled with these issues, tuna fisheries generally lie within multi-national management structures where a single fishery monitoring program must be coordinated among several host nations.

Topic 6. Small-Scale Fisheries

The challenges of monitoring small scale fisheries are very unique. Typically, vessels are small, catch quantities low, activity levels high, and fleet sizes enormous. The standard monitoring approaches used for larger industrial fisheries are not easily transferable to these fleets. EM is seen as a possible option, yet successful deployment will require low cost, autonomous (solar powered?), simple, ruggedized technology, applied at a very large scale. Most practitioners feel there is no ‘one size fits all’ solution and that a range of monitoring tools, and management approaches are needed. There is also no universal definition of ‘small scale’ which complicates the discussion on monitoring solutions.

Topic 7. Machine Learning

Applying EM at the scale necessary for many fisheries will result in the creation of vast amounts of image and sensor data. The large data volumes, the time-sensitivity for data processing and the enormous cost for manual data processing will necessitate some form of data processing automation if EM is to provide significant benefit. Machine learning is developing in other fields where image processing requirements are large, and practitioners feel that it can be successfully applied to routine catch quantification among other monitoring needs. The challenges seem to lie with establishing significant image libraries for learning data sets, aligning technical feasibility of automation with operational benefit among the range of monitoring issues in a fishery, and finding ways to implement automation into emerging technologies and operational programs.

Workshop 3 – Safety

Leaders: Kimberly S. Dietrich, Ken Keene, John LaFargue, and Jenna Rockwell

Background

Safety training workshops have an intermittent history at the IFOMC. Starting in 2004 with "Professional communication and conflict resolution training for observers"(McVea and Kennelly, 2005), safety-specific workshops were also held in 2007 and 2009 (McVea and Kennelly, 2007, Nardi et al., 2010). In 2016, many safety topics were included in the Observer Professionalism Workshop (Kennelly, 2016). For the 9th IFOMC, the organizers sought to revive the safety workshop tradition and focus on topics selected by participants. To that end, a pre-conference online questionnaire was performed to narrow down topics based on participant's needs.

Forty-six respondents representing 14 countries completed the pre-conference questionnaire. Respondents had more than 500 years of combined experience and were split fairly evenly between observers, observer trainers and other observer program-related staff. Respondents noted that their program's safety training ranged from 1.5 to five days. The topics rated as most beneficial to address at this workshop were conflict resolution, psychological health, harassment and drug and alcohol concerns (Figure 1).

2018 Safety Workshop Goals/Format

The goals of the 2018 safety workshop were to:

1. Identify common problems related to observer safety in the selected areas of interest from the pre-conference questionnaire;
2. Provide recommendations to implement during observer trainings and/or debriefings; and
3. Identify best practices to include in observer training and program policies.

The Safety Workshop had 53 participants from 21 countries/regions[24] representing observers, observer program managers/staff, electronic monitoring staff, and non-governmental organization In this workshop we utilized four concurrent 30 minute break-out sessions to share experiences and policies among countries and programs. To encourage participation both an open discussion and an anonymous worksheet was utilized to compile information on some topics. Worksheet challenges included: reading and writing in the English language and some participants felt a lot of pressure to complete the worksheet in the allotted time (5-7 minutes). The organizers rotated among the tables so each group had an opportunity to discuss each topic. We intentionally split observers into a separate group so that they would feel comfortable speaking freely and to minimize any reluctance they may have felt if their managers or employers were present. In retrospect, due to the large number of observers in attendance, we should have split the observer group in two to increase effectiveness. The final hour included a brief presentation by the organizers on the most important points discussed from each sub-group and focused on an open discussion to solidify best practices and provide recommendations to pursue issues identified in the sub-groups. Bobbie Buzzell, an observer participant, was selected to provide the safety workshop overview to the full conference delegation.

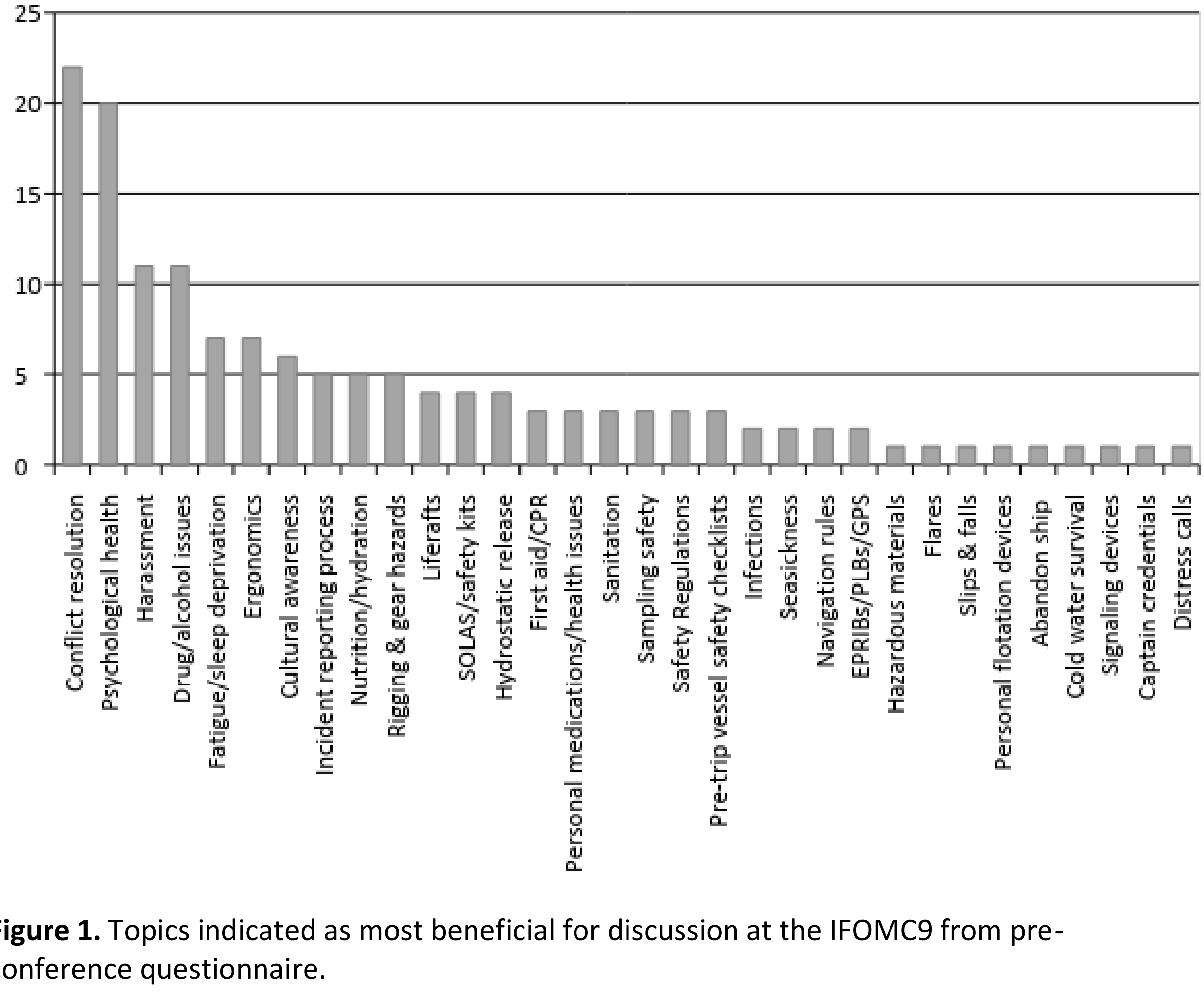

Figure 1. Topics indicated as most beneficial for discussion at the IFOMC9 from pre-conference questionnaire.

[24] Argentina, Australia, Canada, Comoros, Italy, Kenya, South Korea, Micronesia, Nauru, Netherlands, New Zealand,
Portugal, Azores, Solomon Islands, Spain, Sweden, Tuvalu, United Kingdom (several countries), USA, Papua New Guinea

Break-out Sessions

Harassment
Session Leader: John LaFargue

Open Discussion
Questions regarding harassment were designed to target information from both observers and staff. The questions included:

- What types of harassment are most common in your program?
- How common is harassment in your program?
- Does your program have training on harassment and what does it cover?
- Does you program have a protocol for documenting harassment? If so, what are the steps?
- Do you feel most harassment is reported? Why or why not?
- What can be done to encourage reporting?

Several of the issues that came up in discussion were common among many of the programs in attendance. There was a wide variety of concerns brought to the table but a few clearly stood out.

The discussion and worksheet responses showed that some programs did not feel there was much of a problem with harassment and therefore, they did not provide harassment training. Harassment definitions, which likely vary among programs and cultures, were not elaborated upon during the workshop and may have impacted responses to the questions posed. Since some program did not communicate to observers how to identify or report harassment; they subsequently did not have many cases of harassment reported. Most participants felt that harassment was under reported regardless of whether training occurred. Some participants were unsure on what should be reported or were unclear on the process within their own programs.

Participants from programs that did provide harassment training generally felt that harassment was being reported to some extent, but underreporting was still a problem.

It was brought up several times that harassment is not limited to crew and observers but may also include harassment between observers and between observers and staff. The sense was that this type of harassment is drastically underreported and programs need to put more effort into reducing this type of harassment and increasing the reporting of it.

Most participants agreed that the relationships with enforcement agencies could be improved and expanded upon. There was a discussion on a general lack of feedback from enforcement back to observer programs as well as from programs to observers. Participants discussed that having transparency on the process of documentation for observers/staff, and enforcement/agency follow up is critical to increasing reporting.

The ability to communicate incidents from sea came up in multiple groups. Many programs issue devices such as satellite phones or messengers to facilitate private, independent communication between observer and program staff or enforcement.

Most programs have some mechanism for tracking problem vessels, but few if any have one for tracking individual crewmembers. It was acknowledged that this would be difficult, but could drastically increase the safety of observers.

Common Issues

- Not all programs include harassment during training
- Not all programs have clear reporting and documentation protocols
- Incidents are underreported by observers for many reasons. Some of the more common reasons include:
    - Tolerance to harassment is highly variable among individuals
    - Fear of losing job/work
    - Fear of causing problems for vessels/provider/observers
    - Felt it wasn't worth the hassle, nothing would be done
    - Ineffective or non-existent relations with enforcement entities
    - Lack of follow through and communication from enforcement and programs
- Harassment may occur during other aspects of the job including between:
    - Observer/observer
    - Staff/observer

There was a wide variety of best practices being utilized by many programs presented in the discussions. Most of them revolved around education, enforcement and how to encourage or facilitate reporting of harassment.

Best Practices

- Education
    - Increase training for observers/staff on what and how to report.
    - Outline the legal processes involved in prosecuting an offense
    - Outreach to fleet on defining harassment and penalties
- Enforcement
    - Strengthen relationships between enforcement, program staff and observers
    - Include officers in observer training
    - Develop individual offender tracking system
    - Develop anonymous reporting option and/or a reporting process independent from the program or provider.
    - Develop easy & transparent reporting and documentation processes
    - Issue devices for independent communication while at sea

Conflict Resolution
Session Leader: Jenna Rockwell

Worksheet Summary

The conflict resolution worksheet asked participants to: briefly describe a conflict they've encountered during work; the approach they took to address the conflict; level of success (resolved, no resolution, intensified, other); one thing they did that went well; one thing they could have done differently; and did they report the conflict. Out of 53 participants, 41 conflict resolution worksheets were submitted.

Open Discussion

The open discussion gave each participant the opportunity to briefly discuss their conflicts and resolution approaches. In the future we would like to change the format to allow more time for discussion, however it opened a lively conversation of common conflicts and approaches people used that proved successful.

Common Issues

- Language and cultural barriers
- Miscommunication between observer and industry personnel
- Safety issues, trip refusals, avoidance of coverage, compliance, health
- Cooperation from captain/crew, space issues
- Gender based, specifically towards women
- Gossip amongst industry and fellow observers

Common Conflict Resolution Approaches

There were a multitude of approaches discussed in this session. The one thing that remained consistent was each approach to a conflict depended heavily on the mood(s) or personality(ties) of the people involved. This list is not comprehensive and each method may not be appropriate for all situations:

- Speaking with an authority figure, such as the captain or owner. While some used this method with success, many stated that going to the captain or owner could further escalate the problem.
- Enlisting the help of a 'mediator', which could be a fellow observer or crew member.
- Offering 'thank you' cards or some other method of thanks, thus improving future working relations.
- Humor, sarcastic humor being the least effective.
- Pre-trip meetings, especially with captain/crews speaking different languages or of differing cultures. These meetings outline expectations of all parties during the trip and allow everyone to ask questions and clear up any misunderstandings. They also provide the industry with an opportunity to raise concerns about the observer.
- Provide information on regulations. This could be in the form of verbal communications or handouts/pamphlets. One program mentioned handouts/pamphlets were very useful by taking the pressure off the observer.
- 'Kill them with kindness'
- 'Passing the buck'. Observers could defer the issue to program or contractor staff. 'I'm just doing what I was told'.
- Avoidance or silence. Either avoid the conflict altogether or remain silent, letting the conflict blow itself out.
- Be hard working and professional. It's difficult to complain about someone who is working hard.
- Being apologetic and compromising. Come up with a solution that benefits both parties. Collaborate.
- Reporting and real-time communication. This includes the use of an independent communication device the observer could utilize for shoreside assistance.

- Cut off the conversation, or walk away to cool off. This method seemed about 50/50 in terms of effectiveness, some regarded it as dismissive and disrespectful.
- Increased regulations concerning treatment of observers and follow up enforcement. One program recalled a common conflict frequently experienced, and through reporting and better defined regulatory language, the industry responded and the conflict for the most part was resolved.
- Seek assistance from other industry members to act as a positive influence. Have their peers tell them why having observers is a good thing. Or on the flip side, pressure the 'offender' to comply to take the onus off the compliant industry.

The last portion was dedicated to asking each group what they felt could improve conflict resolution and best practices the programs could adopt. The conversations were very positive with many valuable suggestions to implement within the programs.

Best Practices
The overwhelming response from all groups was better training. Not all programs formally address conflict resolution during training, and those that do vary greatly in the amount of time spent and their effectiveness. Utilizing feedback from workshop attendees, wide variations exist across the participating countries and programs in reference to conflict resolution training. Please note these numbers only reflect the information given by participants and may not indicate current practices:

Little, to no conflict resolution training	65%
Conflict resolution training provided	30%
Unknown	5%

Personality tests or indicators such as Myers-Briggs Type Indicator (MBTI) have been used by a few observer programs prior to conflict resolution training as a tool to gain greater awareness of the broad spectrum of personal traits and characteristics. Details regarding this training tool were not discussed in any detail.

- Training
  - Train not only observers, but managers and support staff
  - Mediation training for support staff
  - Use personality tests, such as MBTI, as a tool and its benefit potential in the field
  - As a part of the training, role playing was thought to be most effective by all groups. Also, to include current observers during the training to share real life scenarios and how they handle the situations and having observers engage the training group with scenarios
- Reporting that includes a consistent feedback loop to observer, employer and program staff
- Two-way, independent communication devices, such as InReach, to encourage real time support

- Outreach and training for industry members, this could include informational pamphlets translated into crew's primary language, pre-trip meetings to reduce miscommunication, mediator/interpreter, etc.

Drug and Alcohol Concerns
Session Leader: Ken Keene

Open Discussion
An open discussion was carried out in all four of the Drug and Alcohol sessions, with notes taken on a flip-chart. Over 15 distinct countries were represented throughout the workshop. Within each group, issues with drugs and alcohol were identified in their respective region or programs. A discussion about type of drugs/alcohol, who was using, and how programs handle problems took place. Policies and laws were discussed briefly, but it was determined that is was too diverse amongst all of the countries to address in the short period of time (ranged from tolerated to 0% tolerance). However, the groups did an excellent job identifying "best practices" that were shared with the entire conference.

Common Drug/Alcohol Issues
It was identified that both drug and alcohol use/abuse are issues within commercial fisheries and/or observer programs. Alcohol use and abuse was mentioned as the bigger issue globally from the respondents. The observer group mentioned that it was felt that drug and alcohol use/abuse was on the rise. Alcohol and/or drug use was witnessed of the commercial fishing crew, observers, and observer program employees. There were a wide-range of responses regarding how issues are handled, if training is provided, or professional assistance offered to those affected by drug/alcohol abuse.

Best Practices:
- Decline trip if drug/alcohol use is noticed prior to deployment or end a deployment if possible;
- Observer programs need to build trust for reporting issues and concerns by all involved, this builds a useful support system;
- Follow up to reports is needed to ensure that future reporting occurs;
- When following up on reports of drug/alcohol, protect anonymity of person reporting, particularly observers;
- Brief observers on vessels with history of drug/alcohol reports prior to deployment;
- Incorporate Drug/Alcohol contingencies in EAP's (emergency action plans);
- Provide safety training on drugs/alcohol (signs, symptoms, varieties);
- Provide training in basic first aid and CPR;
- Emergencies can occur anywhere (hotel, home, dock, vessel, etc.), be vigilant and clear headed, particularly if on duty;
- Be professional at all times onshore and offshore (maintain boundaries and credibility);
- Professionalism, or lack of, can be captured and possibly shared on various internet platforms and through the use of Electronic Monitoring;
- Impairment, of anyone, at any time on a vessel should not be tolerated, emergencies can happen in moments;
- Offer drug/alcohol abuse treatment and/or counseling or share information on how to obtain such;

- Use communication tools to explain issues while deployed (sat phone, messengers, cell phone);
- Perhaps make a list of vessels that are so unsafe that observers/staff should not deploy on them;
- Do not confront drug/alcohol users directly about issues of their use/abuse;
- Report all unsafe incidents to the proper channels, follow-ups and feedback are necessary;
- Be positive in making change and helping a user/abuser.

Positive Mental Health and Psychological Wellbeing
Session Leader: Kimberly S. Dietrich

Worksheet Summary
Positive mental health is imperative to observer position due to remote work environment and extreme social isolation. Thirty-three participants completed the psychological wellbeing handout representing at least nine countries[25]. Responses were split evenly between observers, program staff and other related staff. Approaches used to combat mental health issues included: training on how to cope with the job and conflict resolution; frequent, independent communications throughout and after deployment; in-person briefing and debriefing; streamlining of sampling methods to minimize sleep deprivation; peer to peer support groups; crisis hotline and professional counseling benefits.

Common Issues
Participants indicated that anxiety, depression and social isolation were the most common psychological health challenges experienced. Stress, mental exhaustion/burnout and substance abuse were also noted.

Open Discussion
The observer and non-observer groups were asked a slightly different suite of questions; therefore, responses have been summarized separately.

Non-observer Discussion
Few programs have an explicit training module for encouraging psychological wellbeing of observers while deployed. Some related training topics may be mixed within other training elements (e.g., sleep deprivation, personal physical health). One program noted that they teach simple strategies to keep oneself happy while at sea which includes exercise and positive thinking.

Support services for observers deployed and once observers returned ranged widely among programs. While deployed, many programs require observers to check in 1-3 times per week. Participants concurred that regular communication was important. Many programs issue their observers with an independent means of communication which can be used for both work and personal contact. Once an observer returns from a trip, if an incident is reported, some legal support is typical although see harassment section regarding how to improve the enforcement relationship. From a mental health point of view, most programs provide very little support. However, at least one program employs a Critical Incident Stress

[25] Australia, Canada, Italy, Korea, New Zealand, Pacific Islands (many countries), Portugal/Azores, Spain, USA

Management (CISM) paradigm (Mitchell, 2009a). CISM may include a Critical Incident Stress Debriefing (CISD)(Mitchell, 2009b) which could include a group of observers sharing stories among each other and if staff are included, encourages positive and supportive relationships among observers and staff. One US program refers observers who've been sexually assaulted to local resource centers[26] while another offers professional counseling services (albeit limited to three visits). Integrating an in-house Sexual Assault Response Team[27] is another option for programs. Strategies for Trauma Awareness and Resilience (STAR) training is another option for program staff as well as employers to improve their ability to recognize when traumatic events have occurred and respond appropriately. Many programs require debriefing after a trip or certain number of days.

A few employers in the Pacific Islands region require criminal, physical and mental health clearance for observers to be deployed. However, the Pacific Islands area is challenged with inadequate capacity of psychological professionals; it was noted that there was only one psychologist employed in the entire region. A few countries in the Pacific Islands region (e.g., Kiribati, Papua New Guinea) have relatively high suicide rates among the general population compared to the global mean of 10.7 per 100,000 persons (WHO, 2015) which may infiltrate into the observer population as well. Many suicides were discussed during the workshop but as a result of post-workshop follow-up only one program could provide precise statistics for observer suicide attempts while deployed within a discrete time period. These were primarily due to issues with partners and family as well as drug/alcohol. Some Pacific Islands programs have attempted to minimize employment anxiety by encouraging employment consistency through increased contract length and improving communication options before, during and after departure. Note that multiple trips may occur within a contract and trip duration limits were also recommended. The Pacific Islands Forum Fisheries Agency (FFA) EAP includes steps to take as well as an action flow chart for reporting and responding to serious illness and injury, intimidation/assault/harassment, depression/anxiety, attempted suicide, observer overboard, observer missing and observer death (FFA, 2016). The EAP includes the observers, employers, program staff, vessel owners and vessel operators and observers have a copy with them while deployed.

In the US, employers noted that they are legally restricted from asking certain questions in an interview which poses a hiring challenge when it comes to mental health. Over the years, they've learned to listen to what applicants aren't saying as much as to what they are saying. In general, program and employer staff noted they are not mental health professionals and do not have training to identify the warning signs of common mental health issues (e.g. depression, anxiety, PTSD). One participant noted that "emotional intelligence and self-awareness is an overlooked skill that is incredibly valuable to a person living in isolation, who may not be able to detect the onset of depression of anxiety without the social barometer that other people provide." Some program staff have noted that they can determine when an observer is having issues just by changes to data quality and this may initiate further questioning of the observer.

[26] King County Sexual Assault Resource Center (https://www.kcsarc.org/) and Standing Together Against Rape, Inc. (http://www.staralaska.com)
[27] https://www.nsvrc.org/sarts

The benefit of observer mentoring was a popular idea although not many programs implement a formal mentor system and it was noted that there should be support training for the mentors as well if this concept is pursued.

Observer discussion

Observers encounter working conditions that are uncommon to most land-based occupations such as confined spaces, uncomfortable or unsanitary quarters, hazardous working conditions (rough weather, unsecured equipment, incessant mechanical noise), boredom, fatigue/sleep deprivation, social isolation, language barriers and antagonism from the captain or crew. If observers do not take preventive measures to curb and cope with these conditions, their psychological wellbeing may suffer (Miller, In prep). Observers were asked about the types of strategies they utilize while deployed to maintain positive wellbeing while at sea and to combat social isolation. Responses included: humor; empathy; exhibiting a good work ethic; connect with observers while not on boats; personal projects for non-work time; reading; exercise/yoga/stretching; meditation; music/art; journaling; option to communicate to outside world; finding the joy of their job (self-actualization). While physical fitness is closely linked with positive mental health, several women noted it was sometimes challenging to exercise onboard vessels because some crew may sexualize this behavior. The ability to have personal communication time either via satellite phone or communicator (e.g., InReach) was paramount to minimizing stress while at sea.

Another strategy to combat social isolation was to build positive relationships with the captain and crew. Increasing trust between observer and captain is an important component of safety. Managers, observers, fishermen alike perpetuate the dogma that observers and fishermen exist at odds with one another but this need not be the case. One observer noted that if a positive professional relationship can be established between crew and observer, it also creates a safer space for the observer to assert themselves. Alternatively, a few females noted that sometimes any sort of friendliness with the crew can cause future conflict as the positive interaction may be misinterpreted by crew.

Observers discussed their community of support and this ranged widely among programs. Observers noted that some programs require annual observer meetings to review new protocols but also to build comradery among the observers. Other programs met every three or more years which caused the observers to feel somewhat isolated and very little comradery amongst the observers in these programs. Most observers concurred that an independent means of communication on the vessel allowed them to expand their support community to friends and family while deployed and allowed them to feel more secure because they could contact their program in a dangerous situation.

Observers want support resources available to them communicated during training although many noted there were currently no services available to them.

Best practices and recommendations

- Periodic check-in should occur weekly at a minimum and more often in some fisheries;
- Implement trip limits and periodic in-person debriefing requirements;

- Develop peer discussion/support groups, either informal or formal such as CISD and develop observer mentoring programs to foster observers as part of a bigger community;
- Develop a training module for observers focusing on employment stressors, the importance of positive psychological health and strategies to address employment stressors. Additional components could include the link between physical and mental health as well as identifying abnormal feelings while deployed and coping mechanisms to address these feelings;
- Provide professional training for agency and employer staff to recognize basic mental health issues and strategies for traumatic awareness and resilience or similar;
- Policies should be developed to include mental health response in emergency action plans and develop a cheat sheet of support resources for staff and observers which includes informal as well as professional services;
- Further develop a mental health checklist to be used by physicians during periodic physicals. At a minimum, add psychological stressors to the job description used by medical personnel;
- Authorize access to professional counseling services for observers and agency/employer staff which should be independently accessible (i.e., not cleared through employer or agency).

Future Directions

The workshop organizers are grateful for the enthusiastic input from participants and encourage all programs to further discuss, develop and integrate applicable best practices into their programs between conferences.

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Best Poster Awards

As with all our previous conferences, in keeping with our desire to highlight the all-important poster presentations, we only give awards for what are judged to be the best posters presented.

At this conference the number and quality of posters was truly remarkable and resulted in excellent and interactive Poster sessions throughout the week as well as during the dedicated evening poster reception. The Conference Organising Committee together with a host of other judges scored all the posters presented and decided on the following winners:

First Prize:

Regional Scientific Observer Programme (RSOP) of the South West Indian Ocean
Daroomalingum Mauree and Jérômine Fanjanirina, Indian Ocean Commission, SWIOFish

Second Prize:

Challenges of the 60 Feet and Under Commercial Fishing Vessels in Alaskan Waters: An Observer Perspective
Bobby Buzzell, A.I.S Inc Observer, North Pacific Observer Program

Third Prize:

Frequency of Safety and Harassment Violations Types and the Factors that Impede Disclosure
Jaclyn Smith, US National Marine Fisheries Service Office for Law Enforcement

Congratulations to all our winners and to all the poster presenters for their fantastic displays.

Survival Suit Competition

In keeping with our focus on observer safety, at breaks during the week, we ran a special competition for the fastest person and team to don survival suits.

<u>The fastest individual was:</u>

Jenna Rockwell, Fathom Resources LLC with a time of 18 seconds.

<u>The fastest team was:</u>

Soojeong Lee, Seongwoo Koo, and Seonjae Hwang from Korea Fisheries Resource Agency, South Korea, with a time of 42 seconds.

Congratulations to these amazing, and very popular, winners and to all who competed in this vital competition.

Concluding Session and Discussion

Comments from the Conference Chair

The Conference Chair Gabriel Gomez addressed the concluding session by noting that he believed that technology's time has arrived in the field of fisheries monitoring and that the world needs to stop talking about its imminent implementation but to seize it and use it. He noted that there is clearly a need for standards and transparency and that the various instruments and software providers by vendors need to be easily synced. Furthermore, data storage requires standardization across countries and regions. In terms of open source software, he noted that this has its dangers in terms of hindering innovation, that the current model involving competition among vendors is working well, promoting innovation and that open source software will reduce investment by vendors.

He concluded by thanking everyone for their attendance and participation. He noted how honoured and proud he and Marine Instruments were to have hosted the conference in Vigo, Spain.

Comments from the Open Discussion

Lisa Borges, the Organising Committee Chair posed a series of question to the assembly to seek feedback about the conference and future conferences via immediate responses using an online Kahoot quiz. Because of Wi-Fi capability, however, most responses came from European delegates with free 4G access. The questions and responses were:

What did you like most about the workshop you attended?

Importance of content	10
Open Discussions	12
Participants' diversity	13
Organisational Set-up	7

Should the conference continue to include workshops?

Yes	25
Yes but shorter	5
Yes but not concurrent	9
No	2

Which session related themes did you like the most?

Technology-related	15
Observers-related	14
Data-related	3
All the above	28

Should the conference focus on technology or observer-based monitoring?

Technology	8
Observers	8
Equal focus on both	42

Should speakers have more time to present their work?

Yes, at least 10 mins	24
Yes, at least 15 mins	6
No, present 7 mins is OK	27
No, should be reduced to 5 mins	1

Was there enough time for discussion after each session?

Yes, in general	50
No, for some sessions	3
No, should be increased	3

What future session themes would you like to see more?

More data-use related	10
More operational aspects of programmes	16
More observer-related issues	9
Present balance between themes is OK	18

What would you change in the conference?

Shorter conference	3
Having concurrent sessions	10
Meals not included to reduce the price	0
Nothing, it should stay as it is!	40

The conclusion from this small poll basically told the Organising Committee that we more-or-less have it right in terms of the structure, balance and format of the conference. So…. rest-assured, we won't be changing too much in the next one!

There were also a variety of comments from many people in the final wrap-up section of the conference, including several suggestions on how to improve subsequent conferences. But an over-riding theme from all speakers were of a congratulatory nature, noting how successful, productive and enjoyable the conference was.

Suggestions for improvements included:

- The need to focus more on issues regarding fisheries monitoring in developing countries that, after all, catch the majority of the world's fish.
- To incentive higher participation from developing countries
- There is still a strong need for continued focus on the safety of observers.
- A request that copies of oral and poster presentations be made available.
- A possible future session should focus on integrating EM and human observer methods and data.
- That recommendations should come from this conference of experts to relevant international agencies.
- There is a need to not forget about the advantages of being an observer – that it is not all doom and gloom and unsafe – but that it can be a fantastic occupation.
- There were not enough observers present from the EU and there needs a message to go to observer provider companies to send their observers to these conferences.

- Many observers felt that they learnt more at this conference than they did in formal observer training.
- There needs to be more participation at these conferences from the fishing industry.
- Observers would like to meet more observers from elsewhere and have a devoted session run by them at the next conference.

The next conference

Finally, it was announced that the next conference, the 10th International Fisheries Observer and Monitoring Conference will be hosted by the Convention for the Conservation of Antarctic Marine Living Resources in:

Hobart, Australia in February 2021

See you all there!!

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