Report of the

Expert workshop on the methodology to assess and quantify the extent and impact of fisheries bycatch and discards

Casablanca, Morocco, 26-28 May 2015

By
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Contents

Abstract

FAO previously commissioned two global assessments of fisheries bycatch and discards. The first report (1994) provided a yearly mean global estimate of 27 million tonnes of discards. A decade later, an update estimated global average yearly discards as 7.3 million tonnes. These two reports, while not directly comparable due to different methodologies used, suggest a decline in global discarding during the 10 year period between the studies, probably reflecting changes in fisheries management in terms of the implementation of more selective fishing technologies, requirements of eco-labelling standards and growing markets for previously discarded fish.

Recognising the above, and noting that it is 10 years since the last attempt at estimating global discards, and more than 20 years since the first, it is considered timely and prudent to conduct another update on this vital fisheries (and food security) issue via a project planned for completion during 2016. In particular, it is important to have current information on how the world is performing in reducing discards and seafood wastage, and how countries are contributing to enhancing the world's food security.

The first step in the development of this new project to assess current global discards is the formal development of its scope, timeline, methodology and deliverables. This formed the key objective of an Expert Workshop held in Casablanca, Morocco, on 26-28 May 2015. The workshop discussed, validated and agreed on the approach, methodology and a wide range of issues to be addressed in the project in order to identify and quantify the extent and impact of fisheries' discards throughout the world. The workshop also identified a range of potential data sources for the project, the next steps to be taken, and developed a brief concept note to be used to engage potential partners and for information purposes.

In summary, it was decided that the new global update should focus on that subset of bycatch that is discarded from commercial fisheries (excluding recreational and indigenous fisheries). But, unlike previous reports, the new project will include an assessment of discards from inland fisheries. Discard estimates will take a fishery-by-fishery approach, and extrapolations will be done assuming a linear relationship between discards and fishing effort (if available) or catch/landings information. Details of the source of estimates will be provided to enable assessment of data quality. Many potential sources of data were identified during the workshop including: numerous government observer programs; national bycatch reports; reports by RFMOs, NGOs, and eco-labelling organisations; scientific papers; and reports in the grey literature.

The estimate was seen as providing an approach to reducing waste in fisheries. Thus, in addition to the main thrust of the project (estimating global discards), the workshop identified a variety of additional issues where specific FAO advice could foster more responsible fisheries. These issues could be addressed as specific analyses linked to the main assessment. These included: issues concerning "low value/trash fish"; Endangered, Threatened and Protected (ETP) species; social and economic issues such as food security; best practices on discards and bycatch; impacts on biodiversity and ecosystems; ethical and animal welfare issues, policy implications for discarding, impacts of discard caps and quotas, the causes and costs of discarding, and other issues pertinent to responsible fisheries. Other issues to be covered

included at-sea processing waste and shark finning, unaccounted fishing mortalities, best practices for estimating discards, and case studies on impacts including success stories.

Finally the workshop developed a proposed timeline for the next steps required to develop the project and a concept note to be used to build partnerships and generate resources to complete the assessment.

Opening of the workshop

The workshop was opened by Mr Abdellatif Belkouch, Managing Director of the Centre for Marketing Information and Advisory Services in the Arab Region (INFOSAMAK). In his opening statement, Mr Belkouch thanked the Ministry of Agriculture and Marine Fisheries (Morocco) for accepting to hold the meeting under its patronage. He also expressed his gratitude to the FAO for its continuous collaboration and trust in INFOSAMAK. Mr Belkouch welcomed the participants and thanked them for taking part in this workshop. He highlighted that the agenda of the meeting tackles important issues to build an efficient methodological basis for the assessment process of global discards. Mr Belkouch expressed his pleasure at hosting the Expert Workshop and welcomed the participants to Casablanca.

Mr Petri Suuronen, Fishery Industry Officer of FAO's Fishing Operations and Technology Branch (FIRO) then made an opening statement on behalf of the FAO Representative in Morocco, Mr Michael Hage. In the opening remarks, Mr Suuronen noted that under the current production and consumption trends, FAO anticipates that global food production must increase by 60% by 2050 in order to meet the demands of the growing world population. Yet, more than one third of the food produced today is lost or wasted. Discards (and bycatch) represent significant food loss and wastage in the world's fisheries. Food security problems are increasing in many developing, protein-poor countries, especially in those whose main source of protein is seafood. Benchmarking and reporting on fisheries discards is therefore a vital step to improving utilization of seafood resources and reducing such food wastage.

Mr Suuronen highlighted the fact that FAO has previously commissioned two global assessments of fisheries bycatch and discards. The first report (Alverson et al. 1994[1]) provided a yearly mean global estimate of 27 million tonnes of discards (a discard ratio of approximately 35%). A decade later, an update (Kelleher 2005[2]) estimated global average yearly discards as 7.3 million tonnes (a discard ratio of approximately 8%). While the methodologies used in the studies were not directly comparable, these reports nevertheless suggest a decline in global discarding during the 10 year period between them, probably reflecting changes in fisheries management in terms of the implementation of more selective fishing technologies, requirements of eco-labelling standards and growing markets for previously discarded fish.

Recognising the above, and noting that it is 10 years since the latest attempt at estimating global discards, and more than 20 years since the first, Mr Suuronen noted that FAO considers it is timely and prudent to conduct another update of this vital fisheries (and food security) issue via a project planned for completion during 2016. In particular, it is important to have current information on how the world's fisheries are performing in reducing discards and seafood wastage and so how we are contributing to enhancing the world's food security.

Mr Suuronen noted that the first step in the advancement of this new project is the formal development of its scope, timeline, methodology and deliverables. This forms the key objectives of this Expert Workshop which will discuss, validate and agree on the approach, methodology and other issues to be addressed in the project to identify and quantify the extent

[1] Alverson, D.L., Freeberg, M.H., Murawski, S.A. & Pope, J.G. 1994. A global assessment of fisheries bycatch and discards. FAO Fisheries Technical Paper 339. Rome, FAO. 235 p.

[2] Kelleher, K. 2005. Discards in the world's marine fisheries. An update. FAO Fisheries Technical Paper 470. Rome, FAO. 131 p.

and impact of fisheries' bycatch and discards. Mr Suuronen then thanked the experts at the workshop for taking their time to consider these important issues and extended his sincere appreciation to INFOSAMAK for hosting this workshop. He then called the workshop to order.

Participants attending in their individual capacity made short self-introductions noting their background and interest in the assessment of fisheries bycatch and discards.

Workshop Objectives

The key objectives of the workshop were to:
- Discuss, validate and agree on the approach and methodology that will be used in a future project to identify and quantify the extent and impact of fisheries' bycatch and discards throughout the world;
- Develop the scope, timeline, methodology, deliverables and budget for the project;
- Identify a range of potential data sources for the project; and
- Develop a formal prospectus (concept note) of a project for consideration by potential funders.

Conduct of the Workshop

The workshop was held in the Hotel Casablanca Le Lido Thalasso in Morocco on 26-28 May 2015. The workshop involved the participation of 13 international experts with specialization in fisheries bycatch and discards estimation, statistics, management and economics. An additional three FAO staff members participated in the workshop and the entire workshop was administered and organised by the staff of INFOSAMAK. The list of participants is provided in **Annex 1** and the workshop agenda in **Annex 2**.

Each international expert provided a background presentation over the course of the first day and a half (for a description of these presentations, see the summaries attached in **Annex 3**). This began with two introductory, scene-setting presentations about what constitutes bycatch and discards, and why we need global estimates of bycatch and discards (Suuronen, Kennelly). These were followed by a summary presentation regarding the strengths and weaknesses of the previous studies on estimating global bycatch and discards (Kelleher). Mr Macfadyen then presented on some of the economic and social aspects of discards, and how these are linked to food security. These presentations also assessed the progress made in the management of bycatch and discards, discussed new potential approaches and methods for assessing global bycatch and discards (including ways to assess and improve the quality of data) and other relevant issues to be taken into consideration.

The workshop then had a series of presentations summarizing country- and region-specific programs that estimate bycatch and discards. These included presentations about the comprehensive Bycatch Reporting system of the United States of America (Benaka, Faunce), the soon-to-be developed Australian system (Kennelly), the system used to monitor discards in Europe and consequences of the new Landings Obligation (Graham, Damalas), the data collection and discards monitoring program in the EU DiscardLess project (Dalskov), the Norwegian approach to bycatch monitoring and management (Volstad), monitoring issues in

Asia (Suuronen), the situation in Latin America (Mattos), Morocco (Najd), and Sudan (Eldirdiry), and freshwater fisheries in the Nile and Amazon (Eldirdiry, Mattos). Furthermore, specific discussion were conducted regarding the bycatch issues in well-covered tuna fisheries of the world and the not-so well covered places like Gaza and certain countries in West Africa (Kennelly). Following each of these presentations, time was allocated for specific and general questions, commentary and discussion.

These presentations and discussions then led to a clear direction for the remaining day and a half of the workshop (including the issues to be addressed and decided upon) so that the workshop could, by its conclusion, achieve its main goals of (i) providing a clear pathway forward to develop (over the next 2 years) a new assessment of global discards and (ii) developing a draft concept note to be used to raise the resources required to produce such a report.

The steps taken during the remainder of the workshop were: (i) a series of open discussions regarding the scope, methodologies and issues to be covered in the project; and (ii) group work to address particular definitional issues and identify potential data sources. The rest of this workshop report summarizes these discussions and their conclusions.

Discussions and Outcomes from the Workshop

Scope of the New Project

Definitions – "Bycatch" versus "Discards"

The workshop discussed at some length the scope of the new project, especially in relation to whether the project should focus on trying to estimate all "bycatch" or just "discards" (a subset of "bycatch"). Because of the difficulties that the world fisheries sector has had in settling on a robust and standard definition of "bycatch" (which may, depending on the jurisdiction, may include ETP species, discards, juveniles, trash fish, pre-catch losses, slipped fish, offal, and even broader ecosystem and habitat impacts of fishing), the group decided that **the main thrust of the new project should focus on a re-assessment of global discards**. This has the dual advantage of: (i) providing estimates for a relatively discrete subset of the catch; and (ii) providing a means to compare the new estimate(s) with that derived a decade ago by Kelleher (2005). It was decided that other issues surrounding the broader concept of bycatch (see below) should also be addressed in the assessment and project documentation, but done via specialized additional sections of the report – i.e. in addition to the main focus of the report which will be to estimate discards.

In this vein, the group also agreed that it was logical for the new project to consider the definitions of "discards" as provided in Kelleher (2005) and the FAO's International Guidelines on Bycatch Management and Discard Reduction (FAO, 2011). The workshop discussed the inclusion of fish discarded during slipping operations (mainly by purse seines) and the dumping of shark carcasses but not of other offal – noting that both are consistent with FAO's Guidelines' definition of "discards".

A small group then examined such definitions further and developed the following practical definition for "discards" (modified from Kelleher, 2005) which effectively removed slipping and

the dumping of shark carcasses out of the definition but noting that these activities should be included in the assessment as separate issues:

"For this study, discard or discarded catch is the portion of the total organic material of animal origin in the catch which is taken out of the water, thrown away or dumped in the water for whatever reason. It does not include post-harvest waste such as offal. The discards may be dead, or alive."

Other definitions were also discussed and the group decided to adopt the following:
- A "fishery" is to be defined as per Kelleher's definition (2005) which is according to the "target species, and gear used in any area";
- "Catch" is defined as per the definition by Kelleher (2005) and includes all living biological material (excluding plant material) retained or captured by the fishing gear, whether brought on board or not;
- "Live weight" is the weight of the whole catch before any processing;
- "Product weight" is the weight of the landed catch after any processing; and
- "Landings" is the portion of the catch brought ashore or transhipped from the vessel, or taken to an at-sea processing facility.

It was noted that according to the most recent EU Common Fisheries Policy (CFP) legal document (COM 1380/2013) discards are defined as "*catches that are returned to the sea*". This replaced the previous definition (COM 1639/2001): "*discards are the total live weight of undersized, not saleable, or otherwise undesirable fish, discarded at the time of capture or shortly afterwards*". It was also noted that the recent CFP regulation lacks definitions for landings and catches, which were present in the previous version (*'catches' means the total live weight of fish initially caught, i.e. gross catch; 'landings' means the live weight equivalent of the landings, i.e. nominal catch*).

Categories of fisheries to be included

The workshop discussed the broad types of fisheries to be included in the new project. It was decided (like Kelleher's report and the US Bycatch Report) to restrict the project to reporting on commercial fisheries and to exclude recreational and indigenous fisheries. One of the reasons for excluding recreational fisheries concerned the issue of catch-and-release fishing where up to 100% of the catch is released, or 'discarded'.

It was decided, however, that (unlike Kelleher's report) the new project should include inland (freshwater) fisheries in the assessment as it was noted that such fisheries are very significant and new sources of data for discards may be available for key areas (such as the Great Lakes, the Caspian Sea, the Nile and the Amazon).

Methodology

Discards by fishery
The workshop devoted a great deal of time discussing the methodology to be used to estimate discards in the new project. The techniques used previously by Alverson et al (1994) and Kelleher (2005), and also the methods used in the US Bycatch Report and in other key studies

were noted. It was decided to adopt the Kelleher (2005) methodology, focussing discard estimates on fisheries (as per the above definition of a fishery) and using the latest available estimates (which may span several years, depending on when the latest data were collected). Obviously, data for as many fisheries as possible will be gathered but where gaps exist, estimates for similar fisheries/gears and/or locations may need to be applied.

Extrapolations

In terms of the raising/extrapolation methods to be used, it was noted that, on occasion, fishing effort data are available which can be directly used with discard estimates to provide total estimates. Where such effort data are available, they should be used. However, in most cases, the only raising factors available will probably be catch or landings information, requiring discard ratios (by catch/landings) to be extrapolated using these records.

The workshop did agree, however, that where both effort and catch data are available, extrapolations based on both should be provided and compared. Furthermore, it was also agreed that, in the absence of any evidence to suggest a better alternative, such extrapolations should adhere to a simple linear calculation between the discard rate and its effort/catch/landings multiplier.

Quality estimates

The workshop discussed the utility of developing metrics that score the quality of discard estimates (as used in the US system). It was agreed that, whilst developing a global indicator to track changes in the quality of discard estimates would be useful, any such indicator would be, by its nature, subjective and open to significant interpretation. The workshop agreed that it may not be appropriate for such a subjectively produced metric to be owned or endorsed by FAO through its use in the assessment, but the workshop noted that the development of such a metric and similar metrics for catch data quality could be established independently.

In this vein, the workshop agreed that a more comprehensive approach to reporting on the quality of estimates would be to include a field for each record that provides details about the source data (i.e. whether the estimates derive from observer data, electronic monitoring data, logbook data, estimated from another fishery, region, etc.).

Potential sources of data

A small group devoted time to identifying potential sources of discard data that may exist and be used in the project. Firstly, it was noted that a great many more potential sources exist throughout the world than was the case a decade ago. These include data from individual countries, more comprehensive data from regional fisheries organizations (e.g. RFMOs), NGOs, eco-labelling certification organizations, FAO projects, scientific papers and reports. The experts were quickly able to identify a wide range of sources and contacts which are provided in **Annex 4**.

The workshop noted that a relatively simple "first attempt" to obtain country-specific data could be to write to the relevant highest authority in each country citing the existing estimates for that country from Kelleher (2005) and seeking updated information. Such an approach may yield useful updates relatively quickly but is unlikely to cover all countries.

The workshop also considered the special challenges of obtaining discard estimates from developing countries which may not have the resources available to provide the project team

with information. The initial approach to such countries should be at a high level asking for such information and, if necessary, perhaps seek to engage an an FAO consultant working through the RFB to extract and compile the data.

Other issues to be covered in the project and its report

In addition to the above main purpose of the assessment (estimating global discards), the workshop then discussed a variety of additional issues that should be addressed in the project and included in the assessment as specific, dedicated sections. The following is a summary of these issues.

Low value/trash fish, mixed, unidentified assemblages of small fish

Trash fish is a term often used to describe mixed, unsorted unidentified assemblages of small fish that are caught in fisheries, in particular throughout Asia but also in other tropical regions and even in freshwater areas. APFIC (2005) defined "low value/trash fish" as fish that have a low commercial value by virtue of their low quality, small size or low consumer preference. They are either used for human consumption (often processed or preserved) or fed to livestock/aquaculture species, either directly, or through reduction to fish meal/oil.

Such low value fish were once (decades ago) often discarded but have gradually grown in importance initially as a landed bycatch, for instance, from targeted shrimp fisheries and more recently (in some places) as a targeted product in its own right. As such, "trash fish" are not discards nor even untargeted "bycatch" but nevertheless remain a major fisheries issue. This is because the assemblages often contain large quantities of species that, in a sustainable fisheries management regime, would be left to grow, reproduce and be harvested at larger sizes.

The scale of this issue is worth noting because the quantities involved are known to be in the order of 10 million tons and growing as the demand for fish meal for aquaculture increases. Of particular relevance to this issue will be a consideration of recent APFIC (2013) and FAO (2011) guidelines.

Endangered, Threatened and Protected (ETP) species

The discarding of ETP species warrants separate treatment in the project due to the biodiversity concerns and conservation concerns associated with such species. The workshop agreed that such species should be included in the main estimates of discards in a similar way to that done by Kelleher (2005) and the US Bycatch Report - where reporting is done in terms of the numbers of animals (not weights), based on species-specific estimates (often provided by various agencies, organizations and/or individual projects) but not necessarily attempting global extrapolations.

Social and economic Issues

The workshop discussed the inclusion of a section in the report that examines a variety of social and economic issues concerning bycatch and discards. These would include issues such as:

- Food security - A major reason for FAO engaging with this project is because of the implications for food security that are associated with the discard (and wastage) of large quantities of seafood protein. This is especially the case for those areas of the world where a large proportion of protein comes from seafood. Issues such as the loss and

wastage of fish due to discards, the sub-optimal use (both economically and as food for human consumption) of trash fish and the sector that trades in trash fish are all important issues that require attention;

- There are also issues associated with the impacts that discarding has on the loss or damage to biodiversity and ecosystems and the implications of this for fisheries and other industries that rely on such ecosystem services (i.e. the "shadow value" of leaving fish alive in the sea);

- Ethical (and intergenerational) considerations regarding the sub-optimal use of natural resources;

- Animal welfare issues associated with catching and discarding animals;

- Economic implications such as the EU's Landings Obligation which raises sensitive issues with respect to quota levels and practical issues of monitoring;

- The impacts of discard caps, quota trading to reduce discards and trigger or "choke" species;

- The causes of discarding in many fisheries including quota regulations (highgrading), a lack of ice/refrigeration, lack of markets for non-target species, and other economic drivers;

- The impact of poor discard information on stock assessments leading to decreased confidence in assessments and less robust management measures; and

- The costs involved in discarding, in terms of the need to have shorter tows, more crew, the reduced quality of target species and therefore lower prices, etc.

At-sea processing waste, fishing for roe and shark finning

Whilst the discard of fish offal at sea was agreed to not be part of the normal definition of fisheries "discards" in this project, the workshop agreed that it is important to include a section in the assessment that addresses particular issues concerning such waste. Such a section would incorporate issues such as the retention of fins (from sharks), roe from other species, and other similar products, and the subsequent discard of the bulk of the rest of such animals.

Unaccounted mortalities

The workshop considered that it would be important to include a section in the project on unaccounted (or cryptic) fishing mortalities (such as those caused by pre-catch losses, ghost fishing, etc.) even though estimates of such impacts are challenging. A reason for including a discussion of these issues is the fact that some countries include such mortalities as part of their definition of the term "bycatch". Such a section would (necessarily) lean quite heavily on published scientific estimates of these mortalities.

Best practices for estimating discards

It was felt that the assessment should include a discussion of approaches to discard estimation including suggestions for best practices that countries may wish to adopt. Issues to be covered in such a section may include: the design and scope of observer programs, the utility of electronic monitoring (camera) systems, the use of landings versus effort when extrapolating estimates, double counting of landings by two or more countries, and the effects of transshipments on landings data.

Case studies on impacts, including success stories

The workshop considered that the assessment should also describe success stories in discard estimation, reduction and/or management. These would provide examples of best practices to member countries, not only on the technical aspects of discard reduction, but on how fishers and the fishing industry can collaborate in such initiatives.

Conclusions and recommendations

The assessment would conclude by reviewing the policy implications of the estimates provided and the issues discussed and linkages to the relevant UN Oceans processes. These sections would cover implications for fisheries managers in terms of how they could best manage the priority issues associated with bycatch and discards, pathways to reduce waste in fisheries, and recommendations for subsequent iterations of the report.

Timeline

The workshop discussed the process that should occur after the conclusion of the Casablanca meeting and decided on the following timeline:

1. Comments back on the Draft Workshop Report and Concept Note (1-2 weeks)
2. Initiate work on the main task of the project – gathering of discard data from readily available sources (6 months)
3. Gathering of discard data on the rest of potential sources (6 months)
4. Analysis and Extrapolation of estimates (3 months)
5. Write up of additional issues section (6 months)
6. Finalisation of Report

Development of a Concept Note for the Project

The final task of the workshop was to develop a brief concept note for the project which can be used to explain the work to potential funders. This is provided in this report as **Annex 5**.

Concluding remarks

Compared to the situation 10 years ago, the capacity for monitoring and reporting on fisheries in many countries has improved. More programs now exist throughout the world that record and monitor bycatch and discards, including numerous observer programs and other initiatives such as electronic logbooks and smartphone recording. Further, many countries have developed sophisticated systems for capturing such data that were not available a decade ago.

The workshop agreed that the new project will provide a comprehensive update of estimates of discards. It is intended to include more intensive attempts to capture data from individual countries and regions and, where data has been traditionally difficult to obtain, special actions will be taken to locate and extract data for inclusion.

Data will be obtained via more direct involvement of agencies and targeted individuals. Such an approach will not only ensure more accurate information, but also lead to greater and broader ownership of the findings of the report. Numerous contacts in this field have already been developed by FAO and its key stakeholders over the past 10 years in regions where, previously, bycatch and discard information has been difficult to obtain. It is the intention to engage these

networks in the new project and therefore provide more accurate estimates for various countries, regions and fisheries.

The timeline proposed for the next steps in the development of this project is ambitious but achievable, with the entire project aiming to be concluded and reported by early 2017. The concept note for the project provides a brief outline of the project, its drivers, goals, outputs, deliverables and budget. It should be used by all concerned to raise the necessary resources to complete this vital project which, when complete, should greatly enhance our monitoring of wastage in the world's fisheries and raise awareness and incentive to reduce such wastage. In this way the report serves as a driver to contribute to the alleviation of food security problems – especially in those regions where seafood is a major source of protein.

Annex 1 – List of Participants

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Expert workshop on the methodology to assess and quantify the extent and impact of fisheries bycatch and discards

26-28 May 2015, Casablanca, Morocco

Tuesday, May 26 - Day One		
08:30 – 09:00	Registration	
09:00 – 09:30	Opening of the workshop	INFOSAMAK FAO
09:30 – 09:45	Introduction of participants	Brief self-introduction
Background and Introductory Presentations and Discussions		
09:45 - 10:15	What are we hoping to achieve – scope and concepts?	Petri Suuronen
10:15 – 10:45	Progress in the monitoring and management of bycatch and discards	Steve Kennelly
10:15 – 10:45	Discussion	All
10:45 – 11:00	*Break*	
11:00 – 11:30	Re-estimating global discards: methodologies and issues	Kieran Kelleher
11:30 – 12:00	Economic and social impacts of discards and some thoughts on valuation	Graeme Macfadyen
12:00 – 12:30	Discussion	All
12:30 – 13:30	*Lunch*	
13:30 – 14:30	Discussion	Moderator: Siar
Regional, Country and Fishery-specific information		
14:30 – 15:00	The US approach to monitoring, estimating and reporting bycatch and discards	Lee R. Benaka
15:00 - 15:15	*Break*	
15:15 – 15:45	Having it all is not enough – bycatch, discards and	Craig Faunce

	monitoring issues in Alaska	
15:45 -16:00	Discussion	All
16:00 – 16:30	Bycatch and discards in Europe – data collection processes	Norman Graham and Dimitris Damalas
16:30 – 17:00	Bycatch and discards management in Europe – the Landing Obligation	Norman Graham
17:00 – 17:30	Data collection and bycatch/discards monitoring programs in the **DiscardLess** project	Jørgen Dalskov
17:30 – 18:00	Discussion and wrap-up of Day 1	All / Kennelly & Siar

Wednesday, May 27 - Day 2

Regional, Country and Fishery-specific information - Continued

08:30 – 09:00	The Norwegian model for bycatch/discard monitoring, analyses and management	Jon HelgeVølstad
09:00 – 09:30	Latin American and Caribbean bycatch and discard: the monitoring measures used	Sergio Mattos
09:30 - 10:00	Low value/trash fish issue in Asia-Pacific	Simon Funge-Smith& Petri Suuronen
10:00 – 10:30	Discussion	All
10:30 – 10:45	*Break*	
10:45 – 11:00	Compilation and review of information on the level of discarding in some trawl fisheries in Moroccan waters	Amina Najd
11:00 – 11:15	Bycatch and discard issues and monitoring in Sudan and the Middle East region	Nadia Eldirdiry Karoom
11:15 – 11:45	Discussion of Regional, Country and Fishery-specific information	Steve Kennelly
12:30 - 13:30	*Lunch*	

Developing the methodology to estimate global bycatch and discards

13:30 – 14:30	Discussion on the collection, analysis and reporting on bycatch and discards - problems and constraints Assessing the extent and impacts of bycatch and discards: Why asses, what to assess, and approaches to	Moderator: Suuronen Panel: Kennelly, Kelleher &

	assessment	Macfadyen
14:30 – 15:00	**Brainstorming session 1**: <u>Issues</u> in developing an approach to estimate global bycatch and discards – potential scope, assumptions, extrapolations, socio-economics and other considerations	All participants split into 2-3 groups
15:00 – 15:15	*Break*	
15:15 – 16:00	**Brainstorming session 1** - continued	All participants split into 2 groups
16:00 – 17:00	Presentations by the groups on the brainstorming sessions about issues	Moderators from each group
17:00 – 17:30	Discussion and wrap-up of Day 2	Steve Kennelly
Thursday, May 28 - Day 3		
Developing the methodology to estimate global bycatch and discards - Continued		
08:30 – 09:30	**Brainstorming session 2**: <u>Approach and Methodology</u> to be used in the estimation of the extent and impact of bycatch and discards (identification and quantification)	All participants split into 2 groups
09:30 – 10:15	Presentations by the groups on the brainstorming sessions about <u>Approach and Methodology</u>	Moderators from each group
10:15 – 10:30	*Break*	
10:30 – 11:30	**Brainstorming session 3**: <u>Timeline, Deliverables and Budget</u> of the project	All participants split into 2 groups
11:30 – 12:30	Presentations by the groups on the brainstorming sessions about <u>Timeline, Deliverables and Budget</u>	Moderators from each group
12:30 - 13:30	*Lunch*	
13:30 – 14:00	Summary of the work so far and identifying the sections of a prospectus for the estimation.	Petri Suuronen & Steve Kennelly
14:00 – 15:00	Drafting the Prospectus.	All participants split into groups working on different sections

15:00 – 15:15	*Break*	
15:15 – 16:00	Drafting the Prospectus - Continued	All participants split into groups
16:00 – 16:45	Plenary Discussion: Putting together the sections of the Prospectus	Steve Kennelly & Petri Suuronen
16:45 – 17:15	Review and agreement on the draft Prospectus and next steps	All
17:15 – 17:30	Wrap up and close of the workshop	FAO INFOSAMAK

Summaries of presentations

What are we hoping to achieve in this workshop?

- Scope and Concepts -

Petri Suuronen
FAO, FIRO

Background

FAO estimates that global food production must increase 60% by 2050. Currently, more than one third of the food produced today is lost or wasted. In many countries the main source of protein is fish and other products from the aquatic environment. Discards represent significant food loss and waste in the fisheries globally.

FAO has previously commissioned two global assessments of fisheries bycatch and discards. The first report in 1994 yielded a yearly mean global estimate of 27 million tonnes of discards (Alverson et al. 1994). A decade later, an update commissioned by FAO estimated that global average yearly discards in 1992-2001 was about 7.3 million tonnes (Kelleher 2005).

Although the results are not directly comparable, they indicate a decline in global discarding. Significant changes had occurred in many fisheries such as (i) wider utilization of fish previously discarded (new market and processing opportunities), (ii) implementation of new (bycatch) management measures, and (iii) adoption of more selective fishing technologies.

Furthermore, the capacity for monitoring and reporting in fisheries has improved. More programs and methods are in place to monitor and report catches and discards, including (i) dockside and at sea observer programs, (ii) electronic monitoring and electronic logbooks, (iii) smartphone recording, (iv) fisheries surveys, (v) fisher interviews and collaborative sampling schemes, and (vi) onboard video camera monitoring schemes. Many countries have developed sophisticated systems for collecting such data that were not available a decade ago. Nonetheless, in most parts of the world, data on bycatch and discards is still very limited (or none).

What are bycatch and discards?

Alverson et al. (1994) defined bycatch as discarded catch plus retained catch of non-target species. Kelleher (2005) defined bycatch as the total catch of non-target animals. The International Guidelines on Bycatch Management and Reduction of Discards (FAO 2011) noted that there is no international consensus on the definition of bycatch but bycatch may include catch that a fisher did not intend to catch, did not want, or chose not to use. Bycatch may also refer to that part of the catch that should not have been caught because of detrimental ecological and/or economic consequences. Some countries include pre-catch mortality and ghost fishing in their definition of bycatch. Species and sizes considered to be bycatch may be designated in the fishery management plan.

Discards refer to throwing away or slipping of dead fish and fish that may not survive after live release (FAO 2011). The earlier definition (FAO 1996) of discard referred to that portion of the total catch which is thrown away or slipped to the sea for whatever reason. Importantly, discards may be alive or dead. At-sea post-harvest waste have not been included as part of discards.

Why do we need a global estimate?

There is growing concern that the combined effect of failing to effectively manage bycatch and reduce impacts from fishing is threatening the long-term sustainability of fisheries, the maintenance of bio-diversity and is contributing to food insecurity, thus affecting the livelihoods of those dependent on fish

resources. We need to know how the world is performing in reducing discards and seafood wastage. Hence, reliable information on fisheries bycatch and discards is an important step towards more effective management of fisheries resources and the improved utilization of seafood resources, including reduction of wastage.

How the work will be done

The work will be done in two phases. Phase 1 includes the development of a practical and acceptable approach, scope and methodology to the global assessment to be completed in 2015 (i.e., this workshop). Phase 2 includes the eventual assessment and it will be conducted in 2015-2016. We are aiming to a pragmatic, cost conscious, reliable and replicable analysis. The mid-term report will be submitted to Committee on Fisheries (COFI) in July 2016. The project will be finalized in 2017 with a publication.

Subject to the guidance from this workshop, the new global assessment could (i) produce reliable estimates of discards in quantitative terms, (ii) estimate its socio-economic impacts, (iii) estimate food security impacts attributable to discarding practices, (iv) be used for monitoring the trends in discard reduction, (v) build an improved database, and (vi) contribute to bycatch and discard management frameworks.

This workshop will

1. Propose, discuss, validate and agree on the approach and methodology;
2. Develop the scope, timeline, methodology, deliverables and budget; and
3. Develop a concept note (priority actions) for consideration by potential donors and partners.

Workshop output will be a workshop report that will inform further priority actions by FAO in estimating global bycatch and discards, including (i) background papers, (ii) key issues discussed / agreed, (iii) lessons learned from previous global exercises, (iv) approach, scope and the methodology to be adopted, (v) the timeline, work-plan, budget and associated work required; and (vi) a concept note for use in gathering necessary funding to complete a new assessment.

Progress in the monitoring and management of bycatch and discards

Professor Steven J Kennelly
IC Independent Consulting

History

Since humans began fishing (at least 90,000 years ago), fishing technology has developed from simple spears and harpoons to large factory trawlers under an overarching objective of trying to catch the greatest quantities of fish possible, of an ever-increasing variety. After millennia of assuming that seafood resources were inexhaustible, and centuries of muted concerns that new technologies may have detrimental impacts, the last century has seen advances in fishing technology blamed as a major cause of the current over-exploitation of fish stocks throughout the world. Central to these concerns are issues surrounding the bycatch and discarding of large quantities of fish and other organisms. But the last few decades have seen significant advances made in the development and implementation of measures to manage bycatch and reduce discards.

Measures to Manage Bycatch and Discards

The two simplest measures available to manage bycatch involve spatial and temporal closures to fishing. These are successful because, obviously, stopping fishing means there will not be any bycatch nor any discarding. Spatial closures are established to stop fishing in certain areas – often identified because they are particularly sensitive areas in terms of problematic bycatch. Temporal closures are established at particular times or seasons of the year and are usually designed to protect particular species during seasonal aggregations. Both spatial and temporal closures may be fixed or flexible – with the latter requiring ongoing, real-time monitoring of bycatch and discards to inform where and when closures should be established or removed.

Another way to manage bycatch involves setting quotas or "caps" of bycatch or discards. Once a fishing operation (or fleet) exceeds such quotas, areas/times may be closed to fishing for a period or until the problematic species moves elsewhere.

By far the most commonly used way to reduce bycatch and discards involves solutions where fishing gears and/or fishing practices are modified so that less of the problematic species (and/or sizes of species) are excluded from the gear while the gear is still fishing. A great deal of research and development has occurred in this field during the past few decades with many solutions (such as grids and square mesh panels in trawls, the backdown manoeuvre in tuna purse seines, escape vents in pots, etc.) becoming implemented throughout the world.

Management measures such as the above examples are often incorporated into Fishery Management Plans and are also often required for fisheries to achieve 3rd party eco-labelling certification. In all cases, however, it is well-established that the implementation of any such management measure requires monitoring of subsequent levels of bycatch and discards to determine the success (or otherwise) of the measure.

Why we Monitor and Report on Bycatch and Discards

In addition to the above requirements to monitor bycatch and discards, there is also a fundamentally more basic need for such monitoring. Ever since Justinian the Great (540AD) and the establishment of the public ownership of natural resources (the so called "Public Trust Doctrine"), the general public in any society can be said to be the main fisheries stakeholders because this public actually owns all fisheries resources. This ownership is maintained right up to the point where fish are retained for sale or personal use. However, for discarded fish, this public ownership is perpetual – i.e. the public own all discarded fish, all the time. This means that governments (who are given the task of managing this public property on behalf of that public) need to undertake all appropriate activities one would expect

of those with responsibility for managing the property of others. For fisheries discards, this means the proper stewardship, management, monitoring and reporting by governments on behalf of, and to, the public owners.

In recent years the importance of bycatch and monitoring has been recognised in formal international agreements, guidelines and policies, such as FAO's International Guidelines on Bycatch Management and the Reduction of Discards (which recommends that all UN members monitor and report on such things) and the EU Landings Obligation which requires ongoing monitoring of discards.

Methodologies for Monitoring

There are several methods that have been used to monitor bycatch and discards. As is the case for many scientific data collection programs, research vessels were used to quantify bycatch (particularly early in the history of bycatch monitoring) but using such vessels relies on them being able to mimic normal commercial fishing operations. Coast guard inspections have also proven useful to monitor bycatches where vessels are boarded and catches examined whilst at sea (e.g. as in Norway). Post-trip interviews of captains and crews are also used and, whilst such techniques can be quite inexpensive, the data collected on problematic discards are considered to be less reliable and not as accurate as other methods. Monitoring landed catches is an accurate way to quantify landed bycatch at low cost but does nothing to quantify discards.

Getting fishers to self-record data on bycatch and discards is used in many fisheries. This involves fishers completing log-books and, more recently, recording information on laptops which can be sent to scientists and managers in real-time. However, data collected in these ways can be considered less than accurate, particularly for the discard or bycatch of problematic or controversial species. A more sophisticated methodology that operates in a similar way involves the use of study fleets – where particular, "trusted" captains and crews record data which are taken to be representative of the whole fleet.

However, by far the most reliable and accurate way to collect data on bycatch and discards is through the use of onboard observer programs. These involve scientifically trained staff going on normal fishing operations and recording all relevant data. Many such programs now exist throughout the world and they have become a major, mainstream source of fisheries information for many uses but particularly for the collection of data about bycatch and discards.

In more recent years, significant developments have occurred in the use of onboard camera technology to essentially replace human observers for the collection of certain types of bycatch data. Many trials of such "Electronic Monitoring" technology have been completed in many fisheries with several fisheries now adopting such technology as the main way bycatch and discard data are collected.

The Association for Professional Observers provides a list of Observer Programs throughout the world but this list is quite out-of-date and incomplete (http://www.apo-observers.org/programs):

Table 1 – List of Observer Programs from the Association for Professional Observers
Australia
• Australian Fisheries Management Authority Observer Program
Indian Ocean
• Indian Ocean Tuna Commission (IOTC) Observer Program
New Zealand
• Summer Observer Programme
• Inshore Observer Program
Portugal
• Azores Fisheries Observers Programme

United States
• North Pacific Groundfish Observer Program
• Alaska Department of Fish and Game Observer Program
• Alaska Marine Mammal Observer Program
• California - Pelagic Longline
• California - Drift Gillnet
• California/Oregon - Swordfish Drift Gillnet Fishery
• West Coast Groundfish
• Hawaiian Observer Program
• Southeast Pelagic Longline
• Southeast - Shark Bottom Longline
• Southeast - Shark Gillnet
• Northeast - Groundfish
American Samoa
• American Samoan Observer Program
Western and Central Pacific
• Western and Central Pacific Fisheries Commission Observer Programme
• Pacific Islands Forum Fisheries Agency Observer Program
• South Pacific Commission Regional Observer Programme
• Parties to the Nauru Agreement (PNA) Observer Program
• Philippines Observer Program
West Africa
• Liberian Observer Program

In an attempt to compare the above methodologies, Table 2 shows the relative utility and cost of each. The conclusion is that, whilst observer programmes are well-accepted as the best, most reliable, accurate and transparent way to estimate bycatch and discards, they are also considered to be among the most expensive.

Table 2 – Comparisons of Methodologies to quantify bycatch and discards

Methodology	Accuracy and Precision of Bycatch and Discards	Relative cost
Research Vessels	✓ limited in coverage/ relevance	$$
Coast Guard Inspections	✓ but limited in coverage	$$
Port & Dockside Monitoring	✓ landed bycatch ✗ discards	$
Fisher Interviews	✓ but unverified	$
Fisher's Logbooks	✓ but unverified	$
Self Sampling (Study Fleets)	✓ but unverified	$
Electronic Monitoring	✓ but limited in fishery type	$$
Onboard Observers	✓✓	$$$

Reporting from these programs
Data from the above programs, and especially those from observer programs, are used for a variety of purposes including stock assessments of exploited stocks, the quantification of impacts on particular species (especially endangered, threatened and protected species), information about vessel and fleet operations, fishing effort and, of course, data about discards and discarding practices. However, the majority of reporting from these programs tends to occur on a program-by-program basis, with little consolidation within countries, regions or across fishing methods. The data therefore mostly remain "in-house" and can prove difficult to obtain if (as in this project) one is attempting to determine global estimates of bycatch and/or discards.

Consolidation of Reporting

However, in recent years there have been some national efforts to consolidate and report on bycatch and discards. These have tended to stem from national reporting on exploited stocks as done by several countries and jurisdictions (e.g. USA, Canada, New Zealand, Australia, the EU).

By far the most advanced system for national reporting is the sophisticated USA National Bycatch Reporting system described in a later presentation at this workshop. Australia is currently developing its own National Bycatch Reporting System.

In terms of global efforts to consolidate bycatch and discards, we have already noted (in an earlier presentation) that FAO commissioned 2 earlier reports (Alverson et al. 1994 and Kelleher 2005). This current workshop is the beginning of the process to prepare the third.

Some Issues to Consider for this Workshop

As we develop a process for this latest global update on bycatch and discards, there are several issues that need to be considered. The first is the overall scope of the new report and whether it attempts to estimate all bycatch or just that subset which is discarded. We also need to identify the broad types of fisheries to be covered (i.e. do we include recreational, inland and/or indigenous fisheries in addition to commercial fisheries?).

A major issue concerns the general paucity of data on bycatch and discards that exists throughout the world. That is, whilst there have been large increases in the numbers and diversity of observer programs, logbook programs, EM systems, etc. since the last report was done a decade ago, there are still many fisheries, regions and fishing methods for which no such data exist. This means that, as was done in the previous reports, our estimates will need to incorporate many assumptions and extrapolations as we assign estimates from other fisheries to fisheries with no data, and as we aggregate data across regions, fisheries and methods.

We also need to examine the relative quality of our estimates. That is, some estimates will be based on good, regular observer programs, whilst others may be based on less accurate reporting from logbooks, interviews and dockside monitoring. Some consideration of quality tiered systems and trackable metrics (as used in the USA Bycatch Reporting system) may be appropriate.

The costs associated with estimating bycatch is also relevant and concepts such as the use of alternatives including Electronic Monitoring and/or using targeted, short-term programs instead of ongoing perpetual programs should be examined.

Many other issues will arise throughout this workshop as we develop our approach for a new global assessment of fisheries bycatch and discards during the next 2 years.

Re-estimating global discards: methodologies and issues

Kieran Kelleher
Fisheries and Oceans Specialist

The presentation described the definitions used and scope of previous assessments, specifically the methodologies and approaches used in the global assessments done by Alverson et al. (1994) and Kelleher (2005), the assumptions underlying these estimates and the issues arising in preparing the 2005 estimate. The presentation then suggests an approach to the proposed 're-estimate', including possible goals and outputs and the possible organisation and responsibilities for the re-assessment.

Historical assessments

Alverson et al. (1994) defined discards essentially as **all dumped animal organic material whether dead or alive**. Alverson assumed that discards can be estimated by species and that fisheries for each species or species group in the FAO FishStat database have broadly similar discard characteristics associated with the main gears used to harvest them. The advantage of the approach was that it provided a global basis for making the estimate. The disadvantage is that there is no *a priori* link between catch of a species and discards and this generated some errors, particularly with respect to shrimp fisheries in SE Asia where discards are often low or negligible. In 1996, Smith and Duthie used a matrix of species and gears to estimate discards in Atlantic Canada. However this approach proved cumbersome at a regional or global level.

In 2005 Kelleher used a fishery-by-fishery approach to re-estimate global discards. While the definition of discards used by Alverson was retained, the different approach means that it is not possible to compare the 1994 and 2005 estimates. The 2005 estimate included live discards, irrespective of their survival, and numbers of discarded turtles, seabirds, and marine mammals, described as 'incidental catch'. It did <u>not</u> include: recreational discards (catch/release); unrecorded catches; post-harvest waste (with the exception of finned sharks); and un-perceived biomass, such as sponges, jellyfish, corals.

Kelleher assumed that discards are a function of a fishery and that **fisheries can be defined in terms of target species, gear and area**. It was assumed that discard levels are equivalent in 'similar' fisheries, though application of this assumption requires a value judgement in each case. There were a number of raising assumptions (i.e. used to extrapolate the findings of a discard study to an entire fishery). Kelleher used a discard rate indicator defined as the **dumped catch as a % of gross catch** (gross catch as defined by FAO - see diagram). It should be noted that definitions of discards may differ among countries. Although the assessment was essentially a technical report there was also an advocacy message – to reduce or eliminate discards.

Methodological issues

Several issues arose in the course of the 2005 assessment in relation to the linkages between FAO fisheries statistical data sets, the coverage of countries and fisheries, the quality of the information on discards and the raising of discard estimates to the fleet or fishery level. The FAO marine fisheries production data set provides information by species, country and FAO fishing area (not by EEZ or jurisdiction); contains a large proportion of catches described as 'not otherwise identified, i.e. unidentified species; and is acknowledged to under-report global catches as it does not include estimates of un-reported catches by small-scale and illegal fisheries. The catch data is not linked to the FAO fleet data set. Consequently these data sets are of little use for estimation of discards. The Regional Fisheries Management Organisations (RFMOs) maintain separate data sets, generally by fishery. FAO FIRMS initiated (but did not complete) a scheme to establish a global information base by fishery.

In a given discard study it is frequently unclear if the term 'catch' refers to gross catch, landings, or nominal catch (see figure) and it may not be possible to adjust the values to the gross catch common denominator. In addition to the RFMOs, many OECD countries maintain fishery-by-fishery data sets. However, in many developing countries, catch information is not discriminated by fishery.

For each record or fishery in the discard database the following information is required: (a) total catch for the fishery; (b) a definition of the fishery (target species, gear and area); and (c) a discard rate, or discarded quantity. Information often proved incomplete and many fisheries were ill defined resulting in numerous multi-species/multi-gear fisheries. Studies had different objectives: for example, studies focused on stock assessment often recorded discards by number and size of fish, but not by weight. While there are approximately 2500 discard database records, as many as 10,000 reports may have been scanned to generate these records. Many studies confused discards and bycatch, were imprecise, or unusable because of a narrow academic focus. Typically, information on discards and sample size are given but without indication of the total catch of the fishery or indication that the sample is representative of the fishery / fleet, or not. The nature of the information forced the use of, for example, discards from 1996, but catch from 1997. Discard assessments from different years often had significantly different results (requiring a subjective choice based on quality of report). Many queries sent to countries did not elicit responses and there may also be a certain language bias in the assessment as studies in European languages (Eng, Fr, Sp, Por, It, Nordic) tended to receive greater attention resulting in data weaknesses with respect to some countries (e.g. Russia, Korea, China). Similarly there may be a bias towards fisheries with significant discards as these fisheries tend to be the focus of discard studies. As HMS and the Southern Ocean were assessed by ocean (RFMO, CCALMR) and not by country, some double counting could have been possible.

A number of issues arose with regard to the inherent character of the discard data itself. Sampling or recording of discards must be done at sea and observer reports are indispensable but costly. There are differences between real weights, observer estimates and logbook estimates and high variability, or multiple strata within a given fishery. Sampling tends to be insufficient and sampling protocols deficient leading to raising difficulties. There is a lack of an *a priori* correlation between target/total catch and discards and an inability to empirically "explain" discard levels which are related to fisher behavior, regulatory changes, or market prices. Multiple regressions are of limited use in this inherently unstable relationship, while game theory is inapplicable across different fisheries.

Raising itself involves numerous challenges from the sample to vessel to trip to annual catch to fleet and fishery. A linear relationship is assumed (= single stratum) while in some cases it has been shown that there is no relationship with the auxiliary variable (catch) (see *Rochet*). There are differences between the mean of samples and the sum discards/sum catches discard rates. In some fisheries, assumed equivalent discard rate were applied, e.g.: French Celtic Sea trawl to Irish Celtic Sea trawl (but known differences exist between the fisheries). In some cases 0% - 5% discards were applied by default: artisanal fisheries, e.g., Pacific Islands countries; fish meal fisheries (some exceptions, e.g. Peru); and SE Asian fisheries (some exceptions, e.g. Arafura). A cross-check – total national catch (FishStat, or published national catch) vs. sum of catches in discard database sometimes resulted in excesses, more often in deficits (as expected).

With respect to the likely reduction in discards (Alverson / Kelleher difference of approx.19 million tons), at least some of this 'difference' represents fish that was previously discarded but now landed and implies a significant change in the species content or nature of FAO production values (e.g. more smaller fish, less valuable fish). However, this was not highlighted in SOFIA, partly because no significant trends could be distinguished in FishStat. An independent assessment of discards in the USA reached broadly similar results (Rosenberg). Other national estimates should be compared to the 2005 national estimates.

Enhancing the assessment

It is important to have a clear goal for the proposed new assessment and determine whether it will estimate discards or bycatch. Rio 2012 and UNGA 2014 call for: *"manage[ment of] discards and bycatch"* and a key goal of new assessment would be the reduction of wastage in capture fisheries to point of landing, including direct wastage, skewed science from weak, or no discard estimates in stock assessments. Ideally the new report would establish more measurable targets than 'manage/ reduce bycatch/ discards'. As discards are only one part of poorly quantified fishing mortality, ecosystem impacts and social cost of fishing could also be addressed in the assessment. As *"It is not possible to develop a standard international definition of bycatch"* (FAO, FIRO/R957), estimating bycatch may prove challenging and needs to be associated with a clear goal (see Davies 2009 for an interesting definition of bycatch). The assessment needs to focus on key messages, future targets and actions – outcomes rather than outputs such as a report (see box).

Possible overarching goal: reducing discards and waste

How to achieve the goal?
The assessment would need to address policies, approaches and tools:
- paradigm shift with a clear policy position, e.g. zero/ negligible discards, full utilisation
- prepare economic and ecological case for reductions (value, losses)
- mapping the pathway, e.g. 10-year goal, clear steps
- stakeholder buy-in and supporting measures (fleet attrition, support for vessel/ gear changes, market development for unwanted bycatch)
- draw on examples/ best practices/ lessons: NZ, Alaska, Norway

There would be a change in the focus of management measures, e.g.:

- moves from landings to catches, clear objective
- moves from production to mortality
- greater application of precautionary and ecosystem approaches, biodiversity
- active vs static management (Alaska, Bering fisheries)
- bycatch and discard action plans: e.g. USA, Australia
- possible quota changes: accounting for landed discards (e.g. EU, Denmark)

The assessment can be improved in many ways: improved accuracy of the estimate(s), 'fixing' some of the issues raised above, and enhanced national buy-in/ engagement. Its scope can be extended by adding or completing data fields: state of the fishery, value, total 'wastage', discard composition and food security dimensions. The discard database could become an evolving tool (wiki-based?) rather than a static report. Best practices in protocols for inclusion of discards in stock assessments, pathways for discard reduction and elements of environmental accounting could be illustrated.

A new discard assessment needs to: (a) collect the discard data; (b) compile, analyse and archive the data and supporting information; (c) write and peer review the report; (d) publish, disseminate, and consider follow-up actions at global, regional, country levels. Ideally statements for COFI and UN Oceans need to be prepared and a CCRF supplement on discard reduction could be considered. A SOFIA special section may be required. Sources of finance and in-kind support need to be acquired and analysts (institutions/ individuals) need to be engaged.

It is suggested that a core FAO 'secretariat' be responsible for: (a) organisation and financing; (b) compilation, data handling, quality control; (c) report writing (and translations), dissemination, and consideration of follow-up. Agreements or contracts could be made with institutions to undertake some of the work as long as the source materials are provided. Secondly, the FAO core team would engage directly with RFMOs, OECD countries and other large fishing nations to generate discard estimates and develop case studies and analyses. Thirdly, FAO would engage with non-RFMO RFBs to capture small

country and developing country information, and if necessary, engage regional experts to work in close association with countries and RFBs.

There are three basic sources of discard information; (a) (independent) survey of literature (as Kelleher, 2005); (b) direct requests to countries/ research institutes for reports (as Kelleher, 2005), **or** to compile national discard estimates by fishery. The latter may require funding and quality control to ensure compatibility/ interpretation, possibly through preparation of a template – though a template may restrict capture of useful information. In general, information from RFMOs and many OECD countries will be readily available and the challenge will be to capture developing country information. The RFBs can assist in identifying grey literature, local experts and in preparation of requests to their members. The following box identifies the fishery-specific RFMOs and other RFBs.

Using RFOs as 'intermediaries'
RFBs probably minimum of 10 and Fishery specific (RFMOs) 20

Fishery-specific RFBs/ RFMOs

    Northeast Atlantic/ Mediterranean
        Fishery-specific: NAFO, NASCO, NEAFC, JointFish

    SE Asia, North Pacific, South Pacific
        Fishery specific: CCBSP, IPHC, NPAFC, PSC

    Transnational fisheries, tuna and high seas
        Tuna: ICCAT, IOTC, CCSBT, WCPFC (SPC data), IATTC
        Antarctic: CCAMLR (and ACAP)
        Deepsea/ ABNJs: SIOFA,SPRFMO, SEAFO, NPFC,
        Mammals: IWC, NAMMCO

Regional bodies (non-RFMO)
    Northeast Atlantic/ Mediterranean (2)
        Science, management advice: GFCM, ICES
    SE Asia, North Pacific, South Pacific (2)
        Knowledge bodies: SEAFDEC, SPC, PICES, BOBP-IGO
        Policy bodies: APFIC, FFA , (ASEAN Sec.)
    Central / South America (1)
        Knowledge: WECAFC, OSPESCA
        Policy/ trade: OLDEPESCA, CRFM, CPPS, CTMFM
    Africa (5)
        Policy (primarily): COMHAFAT, COREP, SRFC, FCWC, NEPAD Sec.
        Science/ knowledge: CECAF, SWIOFC, Benguela Current Commission
    The Gulfs (1)
        RECOFI, PERSGA

    Other: OECD

Re-estimate in consultation with CWP, ACFR, FIRMS

Economic and social impacts of discards, and some thoughts on valuation

Graeme Macfadyen
Poseidon

Introduction

This presentation focusses on the economic and social impacts of discards. For such impacts it is critical to distinguish between:

1. Bycatch and discards. Much of the literature is very confused about the impacts of these two distinct issues. This presentation focuses only on discards; and
2. The impacts on whom i.e. vessels (and/or processing sectors which may direct/control vessel catch mix especially in developed country fisheries), or society.

There has been much useful work done on this topic over the years, both theoretical and practical e.g. FAO Technical Paper 370, 1997; work by Arnasson in 1994/95 on discards and particularly the role of management regimes in discarding, and Poseidon 2003 paper[3] prepared for FAO on discards which reviewed and presented many case study examples of the economic and social costs of discarding.

On the related issue of ghost fishing, see Poseidon/FAO report at http://www.consult-poseidon.com/reports.asp which is FAO Fisheries and Aquaculture Technical Paper No. 523 Unep Regional Seas Reports and Studies No. 185.

The presentation also provides some thoughts on how and whether to value discards as part of the future FAO work.

Economic costs to vessels of discarding

In terms of the economic costs to vessels, these are largely associated with:

- Time/equipment to sort/discard;

- Lost revenues of the discarded product (if there is a commercial value); and

- Marketing impacts due to consumer concerns over discards which affect buying behavior and impact on both the quantity demanded and prices paid. Such factors have become increasingly important in recent years with eco-labelling schemes, many of which include performance indicators related to either discarding and/or the existence of discard monitoring/recording arrangements.

Discards may arise from both target and non-target catch, and discards of inedible or non-commercial species arguably represent no economic cost to vessels apart from the time requirements to sort and discard.

So-called "non-commercial" catch may be species for which there is no demand, or parts of fish with little/no demand (e.g. shark finning). Other fish may have no commercial value to a vessel because of i) a lack of trade relationships or knowledge to market the fish, ii) because the fish itself is not in demand in the market.

For vessels, discarding is generally an economically rational decision by/for fishers to increase their benefits.

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[3]Poseidon, 2003. Fisheries Discards: An Assessment of Impacts and a Review of Current Legislation and Reduction Programmes

Economic benefits to vessels of discarding

Given that discarding is an economically rational decision by fisheries to maximise benefits, the benefits of discarding to fishermen can be considered in terms of:

- The increased value of the commercial catch (quality, size, species mix) resulting from discards if there are hold/storage or management constraints;

- Reduced costs of handling/storing non-commercial catch and onshore disposal; and

- Avoiding sanctions if vessels are catching illegal fish (and are not able to sell it undetected on black market).

Management regimes (such as quota management, trip limits, minimum landing sizes, sex restrictions) can have a big impact on, and can actually require levels of discarding.

Economic impacts to society of discarding

Most impacts on fisheries populations and the environment typically attributed to discards are actually impacts of bycatch. Thus the economic impacts of *bycatch* may include: *i) Non survival of any fish discarded which is a function of the gear largely, but also time out of water and depth at which fished; ii) Catch of juveniles with an associated impact on future stock growth and resulting foregone benefits; iii) Effect of over-harvesting on commercial fish populations; Existence and bequest values to society of ETPs foregone if they don't survive.*

For discards specifically, economic impacts may include:

- Costs of monitoring/managing and researching discards. In practice, determining management costs specifically on discards is difficult i.e. observers are used to collect discard data have other functions, control agencies which may be tasked with enforcing discard regulations have many other regulatory aspects to cover, etc. Likewise, research on discards may be part of larger research initiatives. There are not thought to be collated/published data on management and research costs associated with discards. The new EU landing obligation as part of the 2013 Common Fisheries Policy reform for example is generating a lot of work (with associated costs) for Regional Advisory Councils and researchers on developing discard plans, and on assessing the potential impacts of the landing obligation on fleets.

- Some discards from vessels may provide an economic benefit if discards (e.g. of non-commercial species) are available as food for commercial species, in particular localized areas, which can then be caught by the fishing sector. In addition, discards available as food may provide a benefit to seabirds which can support seabird populations, but which then may also prey on commercial fish species.

- Downstream lost value-added in terms of product that is not landed but which if it had been could have been utilised by marketing and processing sectors. However, it should be noted that impacts of discards on the downstream sector could be positive if discarding is due to hold limitations and higher value species are therefore landed than would be the case without discards which then flow through the value chain. However the impacts on the downstream sector could be negative if fish are discarded due to management arrangements and would otherwise have had a commercial value through the downstream sector.

- In some developing countries, unwanted bycatch may be bartered/sold at sea generating benefits for crew, so discarding such catch instead can represent a cost.

Social impacts of discarding

There is a need to be clear about considering social costs of *discarding,* not of bycatch. In temperate fisheries, discarding probably increases social benefits in terms of wages and employment given that discarding (where not driven by management regulations) is intended to increase economic benefits to vessels as already discussed.

In tropical fisheries and in developing countries, the negative impacts of discarding on food security may represent a clearer social cost, along with the social benefits forgone from fish not landed and then processed/marketed.

Other social costs can include conflicts arising from discards where some stakeholders wish all catch to be landed and available for sale. However, it should also be noted that landing of unwanted bycatch from industrial vessels rather than discarding it can also result in large quantities of fish being introduced into local marketing situations which can have a negative impact on domestic small scale catching sectors and other small scale traders by driving down prices.

Costs of reducing discards

Landing obligations such as the one being phased in in the EU as part of the CFP reform can result in increased management/enforcement costs, and costs to vessels in terms of "choke" species. Seafish in the UK has been doing some interesting work on this issue (see report: "Landing Obligation Economic Assessment (EIA); final interim report one: choke analysis", March 2015, available on Seafish website). Observer programs, such as those used in the USA, also have significant costs.

Assuming that vessels discard to increase economic benefits to them, then reducing discards by definition should result in reduced unit sales values for *vessels* (in cases of hold limitations).

In cases where discards are because there is no market for catch, efforts to reduce non-marketable catch could involve costs associated with market promotion to commercialize fish currently being discarded.

Valuing the impacts of discards

Valuing all the different costs of discards described above, and being clear to do so separately in relation to the impacts on (i) fleets and (ii) society would be potentially very complex, time consuming, costly, subject to many assumptions, and probably practically impossible at a global level. It would also probably be quite difficult to draw a clear line between bycatch and discards.

One possibility for the future project would be to value the volume of discards based on unit values applied to discarded volumes. However, as already mentioned, much fish is discarded because it has no commercial value, while discards also include ETPs, marine mammals, seabirds etc.

The main focus of the future FAO work may therefore more sensibly be to estimate volumes of discards as a benchmark and then to track progress in this indicator. However, the report could provide some text to discuss more qualitatively the impacts of discards in economic and social terms, perhaps based on some case study information.

The U.S. Approach to Monitoring, Estimating, and Reporting Bycatch and Discards

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NOAA Fisheries operates with a couple of different bycatch definitions, including the definition found in the Magnuson-Stevens Act (MSA), which is the main U.S. fishery law. According to the MSA, the term "bycatch" means fish which are harvested in a fishery, but which are not sold or kept for personal use. The MSA defines "fish" to mean finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds.

NOAA Fisheries generally operates under this broader bycatch definition: Discarded catch of any living marine resource plus unobserved mortality due to a direct encounter with fishing gear. The MSA contains several National Standards for fisheries management, including National Standard 9, which requires that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize mortality of such bycatch.

Other bycatch-related U.S. laws include the Endangered Species Act (ESA). Sections 7 and 9 of the ESA provide that Federal agencies insure that their actions will not jeopardize the continued existence of threatened or endangered species, and prohibit take of threatened or endangered species. In addition, the Marine Mammal Protection Act generally prohibits take of marine mammals except for limited incidental mortality and serious injury in the process of commercial fishing activities. Finally, the National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries drives some NOAA Fisheries seabird conservation activities.

NOAA Fisheries has been using observers to collect fisheries data since 1972. Observers monitor fishing activities throughout the U.S. Exclusive Economic Zone, collecting data for a range of conservation and management issues. During 2013, NOAA Fisheries coordinated 917 observers that observed over 79,000 sea days in 48 fisheries. In 2013, total funding from all sources (including industry funding) for federal fisheries observer programs was US$68 million for observer coverage and program infrastructure (See Figure 1).
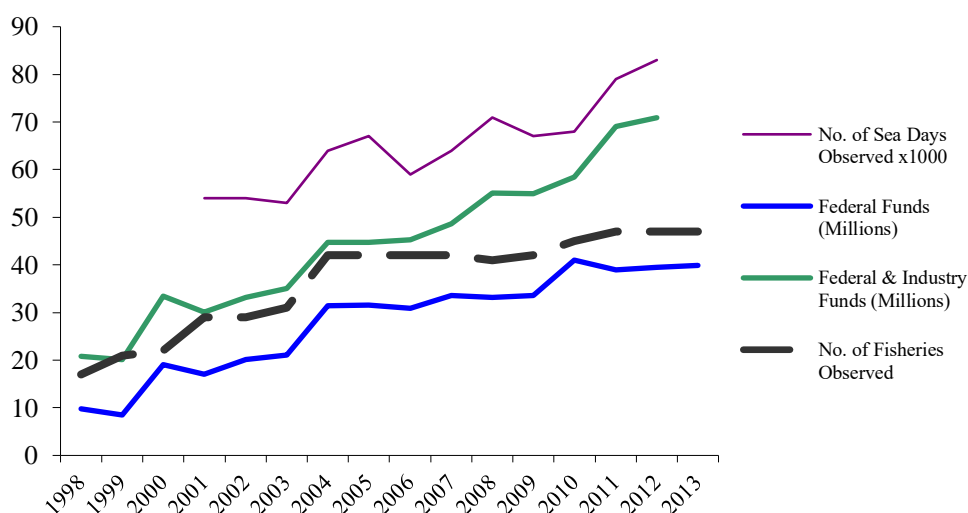

Figure 1. U.S. Observer Program Funding and Coverage Levels

U.S. regional observer programs are located in various regions of the country, including Seattle, Honolulu, and Miami. Levels of observer coverage vary among these programs, from 2% coverage for the Gulf of Mexico shrimp otter trawl fleet (a fleet of a few thousand vessels) to 100% coverage for the Hawaii-based shallow-set pelagic longline fishery for swordfish (which has high levels of coverage mandated by the ESA). Regional Observer Programs are responsible for:

- Sampling protocols and coverage levels
- Safety training
- Observer deployment and debriefing
- Data management and analysis

Regional observer programs utilize a variety of approaches to monitoring bycatch. For example, the Northeast Fisheries Observer Program utilizes a complex approach that attempts to target a precision goal for its estimates. This approach consists of a combination of sampling design, data collection procedures, and analyses used to estimate bycatch in multiple fleets. This structured approach is designed to evaluate the efficacy of the allocation of observer days to multiple fleets to monitor a large number of species under Northeast and Mid-Atlantic U.S. fishery management plans. The program covers 52 separate fleets, 14 fishery management plans, and sea turtles and features an integrated allocation approach for observer coverage based on relative precision and the relative importance of discards for stock dynamics. This program includes methods to ensure that sea day allocations are not driven by imprecise estimates of small quantities, and the program includes new fleets as they emerge. Sea day allocations are based on fishery management plan species, but all species are monitored. However, increased allocations to one fleet come at the expense of other fleets. For many more details on this program, please visit: http://www.nefsc.noaa.gov/fsb/SBRM/

The demands for more frequent, more precise, and more types of fishery dependent data for NOAA Fisheries' science, compliance and management use continue to rise every year. Electronic monitoring (EM) has the potential as a tool to be utilized in a comprehensive monitoring program that would likely also include observers, logbooks, and dockside monitoring. EM purposes include:

- Compliance monitoring – are regulations being followed (fishery and protected species)
- Management – data to support real-time management (individual vessel quotas, catch limits)
- Scientific data collection – assessments, socioeconomic, ecological and ecosystem research

Since 2002, NOAA Fisheries has funded over 20 EM pilot projects, and to date 5 projects have been implemented. These implemented projects include:

- Amendment 80 to Bering Sea Aleutian Islands (BSAI) non-pollock trawl fishery (2007), which requires video recording of sorting activity in bins (or an alternative measure) to prevent pre-sorting of the catch before the observer has an opportunity to sample the catch.
- Amendment 91 to BSAI pollock trawl fishery (2010), which requires video monitoring of all locations where salmon bycatch is sorted by the crew and the location where the salmon are stored until sampling by an observer.
- Amendment 7 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan, which requires EM systems on vessels with Atlantic tuna longline permits and is designed to monitor bluefin tuna catch and discards.

Potential benefits of EM include:

- Suitability across a wide range of vessel sizes, particularly smaller vessels that may not meet all requirements for carrying observers
- Compliance tool for monitoring requirements or prohibitions
- Fully integrated data collection tools that can create a profile of fishing activity at sea
- Potentially lower costs (depending on a number of factors, and the jury is still out)
- 24/7 operation on many vessels (with some exceptions), thereby capturing all events for later analysis or sampling

Challenges of EM include:
- Species identification
- Estimating weights of discarded species
- Archiving and storing huge amounts of data
- Costs and time delays associated with analysis of EM data
- Regulatory and operational constraints, including enforcement (i.e., covering cameras or turning them off)

In 2011, NOAA Fisheries published the U.S. National Bycatch Report (NBR) First Edition. This document included bycatch estimates, mostly based on 2005 data, for 81 fisheries, 480 fish stocks, and 94 protected species. The report documented a U.S. national bycatch ratio of 0.17, and the report comprehensively documented bycatch data sources and analytical estimation methods. This report can be found online at: http://www.nmfs.noaa.gov/by_catch/bycatch_nationalreport.htm

The NBR First Edition included some performance measures that will be used to monitor bycatch trends and changes in the quality of bycatch data collection and bycatch estimation procedures over time. One of these measures is called the Tier System, which is a quantitative means to evaluate the quality of bycatch data and estimation procedures. Tier scores range from 0 (worst) to 4 (best) based on quality of:
- Observer data
- Supplemental data
- Database/IT considerations

Another measure is called Key Stocks, which are stocks with high bycatch levels or special importance to management. Key Stocks are identified based on:
- Bycatch level of the stock
- Management importance of the stock or population
- Overall stock or population status

NOAA Fisheries will publish biennial updates online, with a new comprehensive report published every sixth year, to enable NOAA Fisheries Science Centers to more effectively fulfill stock assessment and bycatch estimation duties, and because year-to-year changes aren't large enough to warrant annual updates. Calculating and inputting two years of data was also considered more efficient and cost-effective than calculating and inputting data annually.

There are several differences between the NBR Updates and Comprehensive Reports. Specifically, Updates will include:
- A short national summary
- Regional summaries, including progress on NBR recommendations
- Updated species-specific and fishery bycatch estimates for all species and fisheries included in the original report (with some consolidation)

Updates will not include:
- A national bycatch ratio or regional bycatch ratios
- Discussion of performance measures
- Detailed discussion of bycatch estimation improvement plans

These last three items are labor-intensive and would prevent timely reporting of updated bycatch estimates. Table 1 shows the NBR schedule through 2023.

Table 1. National Bycatch Report Schedule

Year	Document Type	Data Years Included
2011	Comprehensive Report (First Edition)	2005
2013	Online Update (First Edition Update 1)	2010
2015	*Online Update (First Edition Update 2)*	*2011, 2012, 2013*
2017	Comprehensive Report (Second Edition)	2014, 2015 + synthesis of 2010-2015
2019	Online Update (Second Edition Update 1)	2016, 2017
2021	Online Update (Second Edition Update 2)	2018, 2019
2023	Comprehensive Report (Third Edition)	2020, 2021 + synthesis of 2016-2021

NOAA Fisheries published the NBR First Edition Update 1 online in January 2014. The Update contained 573 fish bycatch estimates based on data mostly from 2010. Each region of the United States provided some additional bycatch estimates compared to the estimates found in the NBR First Edition. The NBR does not include bycatch estimates for all U.S. fisheries, but NBR bycatch estimates cover 58% of total U.S. fishery landings (see Table 2). Southeast U.S. fishery landings include 967,025,000 pounds of Gulf of Mexico menhaden. Because NOAA Fisheries is unable to estimate bycatch for this fishery due to logistical and confidentiality issues, the menhaden fishery is not included in this update, resulting in the low percentage for the Southeast region.

Bycatch estimate numbers went down for several fisheries between the NBR First Edition (based on 2005 data) and the Update (based on 2010 data). For example, in the West Coast bottom fish trawl fishery, bycatch made up 20% of total catch in 2010, down from 34% in 2005. In the Alaska longline fishing fleet, seabird bycatch decreased by 50% from 2005 to 2010 due to the use of streamer (tori) lines and other measures. Northeast spiny dogfish catch decreased from 21.5 M lb in 2005 to 14.5 M lb in 2010. In addition, Gulf of Mexico shrimp trawl bycatch decreased from approximately three pounds of discards for every one pound of shrimp to two pounds of discards for every one pound of shrimp. NOAA Fisheries continues to study improved bycatch reduction devices that might reduce the shrimp bycatch further.

Table 2. Landings for NBR Fisheries with Fish Bycatch Estimates, Compared to Overall U.S. Fishery Landings.

Region	NBR Fish Landings (lb)	Total U.S. Fish Landings (lb)	NBR Landings as a % of Total Landings
Northeast	860,171,000	1,362,914,000	63%
Southeast	133,457,000	1,401,954,000	10%
Alaska	3,285,446,000	4,347,449,000	76%

West Coast	482,279,000	1,070,967,000	45%
Pacific Islands	23,708,000	28,069,000	84%
Total	**4,785,061,000**	**8,211,353,000**	**58%**

The author has identified the following international challenges for bycatch estimation:
- Obtaining basic effort and bycatch data from additional countries.
- Ensuring that countries have the ability to take action required for bycatch estimation (i.e., government authority v. Co-ops).
- Grooming regional leaders/experts who can help their countries, and neighboring countries, implement bycatch monitoring and estimation programs.

The author also has identified the following challenges to domestic observer programs:
- Flat federal U.S. budget that does not allow for observer program expansion.
- Pressure to implement electronic monitoring programs.
- Court decisions that restrict observer programs.
- Lack of consistency in industry funding of observer programs around the United States.

Having it all is not enough: bycatch, discard and monitoring issues in Alaska

Craig Faunce (USA)

What follows are my professional opinions based on my experience and do not represent the views of the National Marine Fisheries Service. Unlike other areas of the United States, the groundfish domestic fisheries of Alaska evolved relatively late in time compared to the rest of the Nation (1970's) with an observer program in place. Consequently, there is a high level of cooperation from the larger and older members of the fleet that are responsible for the majority of biomass removal in Alaska.

The North Pacific Observer Program that operates in Alaska is the largest of its kind in the world and accounts for half the observer coverage in the United States. It employs hundreds of people, places a premium on safety and scientific sampling design, and uses technology to rapidly transfer data. This facilitates a complex suite of rules to control fishing to be implemented by the Alaska Regional Office of the NMFS that include: trip limits, limited entry, and quota sharing systems (community development, cooperative, and individual). Catch limits are managed in near real-time. Fishers that are members of catch sharing agreements are also data consumers, and see the value in having accurate and timely information on catch which they use to manage and trade catch and bycatch quotas between vessels. Consequently the groundfish fisheries of the North Pacific (Alaska) enjoy the reputation as being among the best managed in the world (Worm et al. 2009).

The success of Alaskan groundfish management is important because of its size. The area that is federally managed covers 842,000 nm2 (2.8 million km2). This large area supports a catch in 2014 that was in excess of a million metric tons.

The observer program uses complete observation or fleet-based sampling (Cotter and Pilling 2007). Observers record the amount and percent retained of every species encountered. The deployment of observers is based on a simple-random design. Sampling units (trips, vessels) and strata are defined by characteristics known before fishing begins. Deployment represents the first tier of a hierarchical design with randomization at each level where trip > haul > species composition sample > length sample > biological tissue sample. Alaska quotas are managed based on total catch. Estimates of total catch occurs in several steps. Simple ratio estimators are used to raise sample data to the haul. Discard rates from observed hauls are applied to landing information to generate total catch for a domain (Cahalan et al. 2014).

Decisions regarding the allocation and regulation of fisheries in Alaska are guided by a Council process. This process incorporates advice from science and industry. In this way Alaska is inclusively managed, and co-management has been proposed as the only realistic solution for the majority of the world's fisheries (Gutierrez et al., 2011).

For the reasons above, Alaska is often used as an example of an area of the world that "has it all": a large statistically based observer program, near real-time quota management and a transparent decision making process. Tradeoffs between flexibility and reliability still exist in this area of the world, and these are raised in annual reviews of observer deployment (NMFS 2015) and analyses of estimation routines (Cahalan et al. in press).

What follows are some issues that have arisen in the sampling of catch, the estimation of bycatch, and the utility of such information from my experience in Alaskan groundfish fisheries. They are intended for illustrative purposes.

Bycatch cannot always be avoided. It can be required. Pacific halibut is a regional example. Trawl vessels and hook and line vessels without an IFQ permit holder on board are prohibited from landing

this bycatch species. Consequently, they must be discarded. A vessel with an IFQ permit holder on board must discard halibut below a certain size.

Bycatch can also be incentivized. An example of how fishery specific bycatch data can perhaps be misleading comes from the U.S. National Bycatch Report Update 1 (table 5.1). Fisheries in that report are defined by area + gear + predominant species. In that report, the Gulf of Alaska trawl sablefish fishery is a high bycatch fishery (discard ratio of 0.45). The second most predominant species of catch is grenadier and the principal species of bycatch is arrowtooth flounder. This fishery also really doesn't exist to managers. How is this possible? Trawl vessels participating in the rockfish fishery cooperative are allocated principal and secondary species. One of these secondary species is sablefish. In 2010, the shoreside processing value of rockfish was $0.71, grenadier was non-existent, arrowtooth was $0.41, and sablefish was $7.19 (Fissel et al. 2013). Vessels participating in the rockfish fishery make some trips where the principal species is sablefish, and bycatch is dominated by grenadier. Consequently such trips enter the database and are labelled as a trawl sablefish fishery. The sablefish, not the rockfish target, is the economic driver of the rockfish fishery.

I feel it is necessary to talk about optimization, and why I feel it's a bit of a fool's errand. As soon as the North Pacific Observer Program had incorporated randomization procedures into all levels of its design, questions arose as to when an optimized program would be finished. Many people want to accomplish an efficient sampling program, but to do so requires knowledge of your goals. That is, one needs to know what to optimize on.

The trouble is that setting objectives is quite difficult in a public process. This is because it exposes decision makers to risk, since those objectives may not be popular. The trouble with setting popular objectives is that they can be a moving target. For example industry, politics, and science opinions differ on what is important. However, most everyone can agree that bycatch is bad (but see Zhou 2008). Therefore decision makers may task an Agency with producing fishery specific estimates of bycatch, such as is done in the U.S. The trouble these face for monitoring programs is that there is great temptation to use these as a metric to focus monitoring efforts. I argue that programs that are "inefficient" but yield unbiased estimates for all species and gear groups may be better than an efficient design with poorly defined or rapidly changing priorities. Besides, it may be possible to improve the efficiency of the monitoring through the use of alternative estimators.

Cahalan et al. in press recently compared the relative performance of three estimators for catcher vessel and catcher processors. In that study, a one size fits all approach to estimation routines was not found. Instead the best (lowest error) estimator was determined largely by vessel activity and amount of available data. Although simple mean estimator had attractive qualities, it does not result in stable estimates over time. Therefore, the imputation routine that is currently in use is a more attractive estimator for in-season quota managers for catcher vessels than a design-based estimator with lower error.

Regardless of how catch and bycatch estimates are generated, their meaning has been debated in academic circles ever since the release of Kelleher (2005). These diverging viewpoints are led by Daniel Pauly on one side, and Ray Hilborn on the other. Pauly argues that catch is related to abundance, and that the majority of stocks are in decline. Branch et al. (2011) argue that large stocks and those with stock assessments demonstrate poor a relationship between catch and abundance. This point was then argued by Froese et al. (2013). In that study, the authors argue that only looking at stock assessment fisheries is biased, and that the year of maximum catch is highly correlated with MSY. Therefore catch trends = fishery status.

Regardless of which side of this argument is correct, there is ample evidence that the estimates of official catch, especially for coastal species is likely biased low. Examples from the literature include:

coastal catch from the Arabian gulf was estimated to be 6x higher than official estimates (Google Earth; Al-Abdulrazzak and Pauly 2014), catch was estimated to be 1.6-4x higher than official records in Senegal (Belhabib et al, 2013), total estimated catch of lobsters landed was 14x official records (Kleiven et al. 2012), small-scale fisheries have high bycatch rates (Peckham et al. 2008), and Baltic Sea estimates of removals is 35% higher than reported due to unreported landings, discards and recreational removals (Zeller et al. 2011). While the above represent alarming examples, it is important to recognize that P-hacking, where studies that have significant results are more likely to be published, does exist in the literature (Head et al. 2015).

Sometimes it is difficult to discern whether there is more debate in whether the catch or bycatch amounts are correct, or the meaning to derive from them. Measuring the impact that bycatch amounts represent is hard to gauge. It may be that using bycatch and catch amounts is of limited utility in this endeavour. There are other ways to assess whether bycatch is important, and these involve evaluation of the relative risks of achieving management objectives (risk matrices) and whether bycatch levels are sustainable (productivity and sustainability indices). These methods have even been incorporated into hierarchical management constructs (Hobday et al., 2011).

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European fisheries should operate without discards. This aim has been clearly expressed by both the European Union (EU) and other fishing nations in Europe, together with the overall intention to reduce the environmental impact of societies. In accordance with this, the landing obligation in the new EU Common Fisheries Policy (CFP) aims for a gradual elimination of discards of commercially exploited stocks on a case-by-case basis (Regulation (EU) No 1380/2013 of the European parliament and of the council of 11 December 2013 on the Common Fisheries Policy). The landing obligation encompasses a subset of the catch only, whereby many species will still be legally discarded. This policy will thus lead to less discarding rather than discard-free fisheries. The name of project *"DiscardLess"* reflects this important nuance.

The objectives of the *DiscardLess* are to develop practical, achievable, acceptable and cost-effective Discard Mitigation Strategies to either avoid or utilise unwanted catches, in order to reduce discards while maintaining viable fisheries. *DiscardLess* will integrate knowledge, tools and technologies at local, national, EU and international levels to provide and promote the solutions needed to implement such strategies throughout the seafood supply chain. Further, the project will assess the effects of discard reduction policies on the ecosystem, economic and social sustainability, and will provide feedback for improved fisheries management. *DiscardLess* results will thus be essential in the achievement of policy goals of reducing waste and increasing the net economic value of fisheries for society.

Therefore, *DiscardLess* will provide the knowledge, tools, and methods required for the successful reduction of discards in European fisheries. To achieve this, *DiscardLess* will work through collaborations between scientists, stakeholders and policy makers to support and promote practical, achievable, acceptable and cost-effective discards mitigation strategies, and to make the EU landing obligation functional, credible and legitimate.

The good intentions of reducing discards in EU fisheries must be followed by effective implementation using the right methods and processes on a fishery specific basis. In the 2015 North Sea demersal fishery alone, the introduction of a landing obligation, without changes in behaviour of the fishery or marketing of currently discarded catches, would result in forgone landings worth 300 Mio. Euros (about 47% of total landed value) for the main commercial species, as a result of the fishery being halted when the first TAC is exhausted (ICES, WGMIXFISH 2014 report). However, on longer time scales, landing discards has the potential to increase the earnings of the fishery while promoting human health and the prevention of chronic diseases. *DiscardLess* will address both the short term challenges and the potential benefits to allow the practical implementation of the landing obligation while making it understandable and legitimate across the whole supply chain, from stakeholders to consumers. To specifically address these challenges, *DiscardLess* will work in close cooperation with stakeholders and policy makers to:

A. *Assess the impact of discards on the ecosystem, economy and society.*
B. *Investigate the drivers of discarding, and identify how those can be abated.*
C. *Develop user-based innovative tools and strategies to avoid unwanted catches.*
D. *Develop innovative methods and new value chains to handle and use unavoidable unwanted catches.*
E. *Enhance controllability of and compliance with the landing obligation policy via the development of operational and cost effective tools for traceability and monitoring.*
F. *Formulate policy guidelines to reduce incentives to discard and promote the adoption of alternative mitigation strategies, and support other maritime policies.*
G. *Integrate the gathered knowledge on discard mitigation strategies and transfer it widely.*

The collaborative approach of *DiscardLess* will ensure that the developed tools, information and strategies will provide relevant, acceptable and cost effective means with a wide uptake in society which will result in the achievement of the goals of the landing obligation.

The *DiscardLess* project extends for 48 months (~ 2015-2018). The *DiscardLess* project is coordinated by Dr. Clara Ulrich, DTU Aqua, Denmark and is in total having 31 partners in 12 countries; 9 universities, 9 SMEs, 8 research institutes, 3 industries and 2 organisations.

Latin American and Caribbean Bycatch and Discard: Monitoring Measures Used

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1. INTRODUCTION

The following is a summary of the current state of bycatch and discard knowledge and practices in Latin American and Caribbean (LAC) Region countries. There is an existing consensus that fisheries bycatch and discards is probably one of the most important problems facing the fishing industry nowadays. Problems in assessment and management arise from differences in data collection and descriptions and definitions of a wide variety of fisheries. Finally, the lack of consensus on a universal definition of "bycatch"and "discards"" has led to misinterpretation, which may lead to a wide range of management and monitoring problems during plan implementation

Specifics fisheries were chosen at random, for which information was available, considering identified Large Marine Ecosystems (LMEs). A fishery-by-fishery approach was considered and the following information was collected: fishing methods and gears, the target species of the fisheries, its main bycatch species or group of species, incidental catches (protected & endangered species or group of species), and the monitoring and management measures used.

2. UNDERSTANDING FISHERIES BYCATCH & DISCARD IN THE LAC REGION

Following Alverson *et al* (1994), bycatch and discard data reported for various regions and fisheries differ from fishery to fishery, bringing forth challenges for LAC Region. In orderto quantify and manage byctach, at local and national levels, the following definitions were adopted: i) the expanded Magnuson-Stevens Act (MSA) Section 3(2) (1996): "*discarded catch of any living marine resource plus retained incidental catch and unobserved mortality due to a direct encounter with fishing gear*"; ii) FAO Fisheries Report No. 547 (FAO, 1996): *discards, or discarded catch is that portion of the total organic material of animal origin in the catch, which is thrown away, or dumped at sea for whatever reason. It does not include plant materials and post-harvest waste such as offal. The discards may be dead, or alive.*

Assuming the above definitions represent a comprehensive, but not globally accepted, summary of bycatch and discards, the following examples serve to corroborate the definitions and provide examples of bycatch and discard management worldwide:

- ✓ An index has being proposed to quantify and estimate bycatch and discard: e.g. landings per unit of effort, or fishing power, whatever capacity chosen.
- ✓ The problem in using a fishery as a unit is the difficulty to assess existing data on bycatch and discards due to differences and distinct fisheries characteristics, and regulations measures used in LAC Region countries.
- ✓ Small Scales Fisheries (SSF) deserve specific attention due to high pressure on coastal and estuarine ecosystemS. Other issues include poverty alleviation and livelihood diversification and sustainability.
- ✓ National policies and objectives (e.g. prioritizing food supply), markets, food preferences, fishery economics and moral orientations all influence discard practices.
- ✓ Fishers' decisions _versus_ public concern: bad public image; limitations on the use of resources; behavior in managing a fishery (i.e. future yield); etc.
- ✓ Analysis focuses on a portion of the bycatch caught with a particular gear type or in a particular fishery, with less or no consideration on many other bycatch and discard issues.

3. SCOPE, APPROACH AND METHODOLOGY

The information presented here was compiled from three principal sources: (i) scientific literature and published national fisheries information; (ii) reports and "grey" literature available on the internet; and (iii) contacts with experts in national fisheries administrations, research institutions or regional fisheries organizations, although none of them provided detailed reports and databases.

In the LAC Region, it is appropriate to analyse fisheries according to the scope and approach of Large Marine Ecosystem (LMEs. According to the definition utilised by FAO, Large Marine Ecosystems (LMEs) are regions of ocean space encompassing coastal areas from river basins and estuaries to the seaward boundary of continental shelves and the seaward margins of coastal current systems. Sixty six of them have been identified (Figure 1). They are relatively large regions (200,000 km^{2}or more) characterized by distinct bathymetry, hydrography, productivity and trophically dependent populations.

For the purpose of the present analysis, choosing the LMEs approach meant to create the necessary cluster according to the definition utilized by FAO and the encompassed characteristics identified for each ecosystem. Eight LMEs was identified: Gulf of Mexico Large Marine Ecosystem – 5 (Mexican Fisheries); Pacific Central-American Large Marine Ecosystem – 11 (Mexican Fisheries); Caribbean Large Marine Ecosystem – 12 (Barbados, Costa Rica, Puerto Rico and Colombian Fisheries); Humboldt Current Large Marine Ecosystem – 13 (Colombian and Peruvian Fisheries); Patagonian Shelf Large Marine Ecosystem – 14 (Argentinean and Uruguayan Fisheries); South Brazil Shelf Large Marine Ecosystem – 15 (From Espírito Santo to Rio Grande do Sul States); East Brazil Shelf Large Marine Ecosystem – 16 (From Piauí to Bahia States); and North Brazil Shelf Large Marine Ecosystem – 17 (northern Brazil Fisheries).

Another approach considered was the identification and description of fishing methods and gears for a given area, country or fishery. In order to harmonize concepts, the main categories of fishing methods and gears identified by FAO and those adopted by SEAFISH (2005) were utilised in this survey.

4. MAIN FISHERIES AND MATRIX OF FISHING LICENSE IN BRAZIL.

Under coordination of the joint management system between the Ministry of Fisheries and Aquaculture and the Ministry of the Environment, an institutional matrix in charge of fisheries management in Brazil and a legal instrument (Interministerial Normative Instruction nº 10/2011, BRAZIL, 2011) were created to deal with "*general rules and organization of a license system aiming at permitting fishing vessels for the access of the sustainable use of fisheries resources, defining the fishing methods, species to be caught and fixed areas of operation*".

Such a matrix is detailed in the template below and was the main source of information to define and describe *fishing methods and gears, the target species of the fisheries, its main bycatch group of species, incidental catches (protected & endangered group of species) and the monitoring and management measures used*", not only in the Brazilian context, but for the proposed geographic groupings for fisheries in the LAC Region.

It is also worth noting that considering the huge dimension of the LAC Region and the specificities, at regional and local levels, of the existing legal and institutional framework, data collection was not properly completed, due to differences in the utilized methodologies and political system, increasing the difficulty of access. An example of the Brazilian fishing license system is shown.
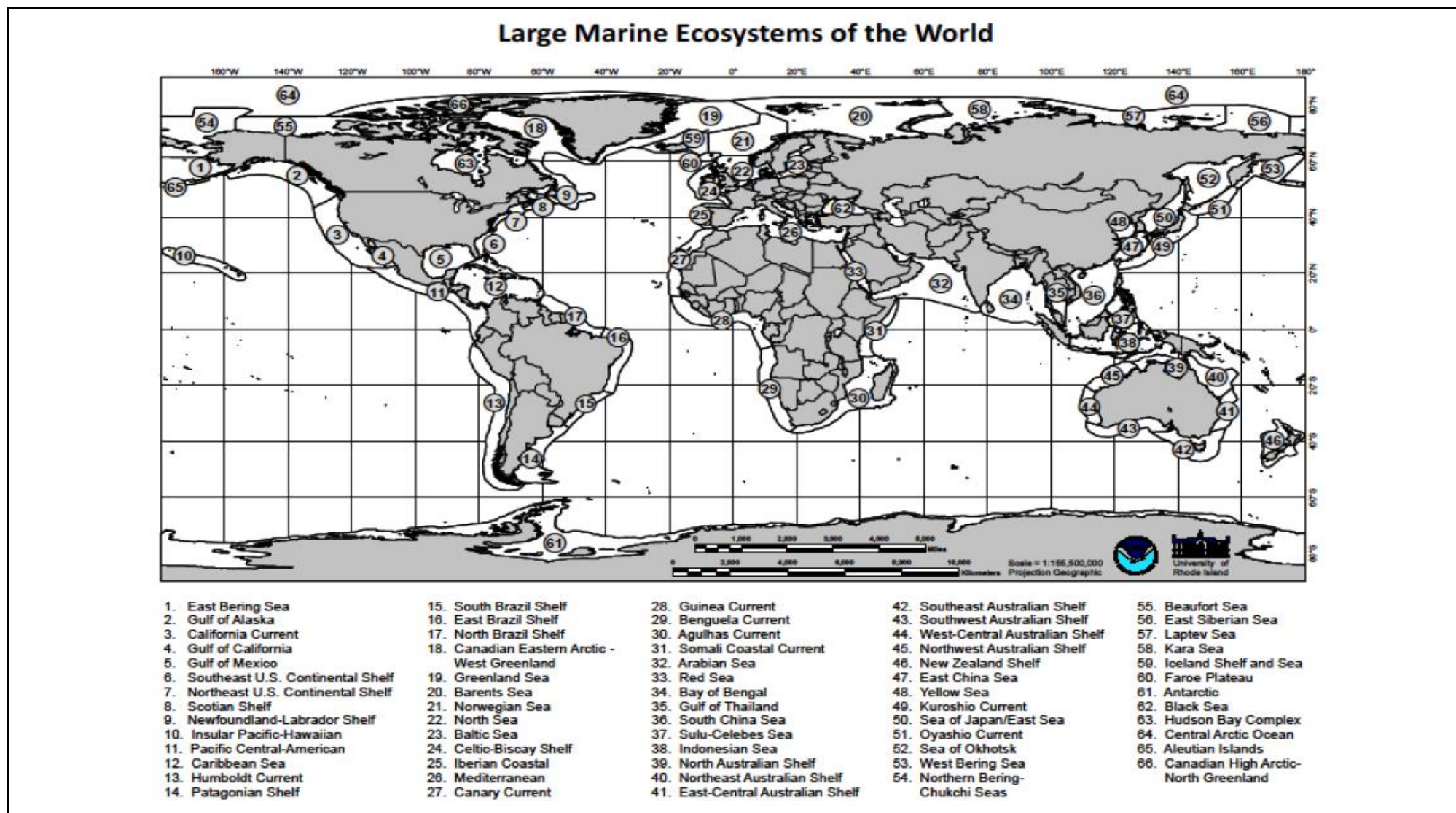
Large Marine Ecosystems of the World

1. East Bering Sea
2. Gulf of Alaska
3. California Current
4. Gulf of California
5. Gulf of Mexico
6. Southeast U.S. Continental Shelf
7. Northeast U.S. Continental Shelf
8. Scotian Shelf
9. Newfoundland-Labrador Shelf
10. Insular Pacific-Hawaiian
11. Pacific Central-American
12. Caribbean Sea
13. Humboldt Current
14. Patagonian Shelf

15. South Brazil Shelf
16. East Brazil Shelf
17. North Brazil Shelf
18. Canadian Eastern Arctic - West Greenland
19. Greenland Sea
20. Barents Sea
21. Norwegian Sea
22. North Sea
23. Baltic Sea
24. Celtic-Biscay Shelf
25. Iberian Coastal
26. Mediterranean
27. Canary Current

28. Guinea Current
29. Benguela Current
30. Agulhas Current
31. Somali Coastal Current
32. Arabian Sea
33. Red Sea
34. Bay of Bengal
35. Gulf of Thailand
36. South China Sea
37. Sulu-Celebes Sea
38. Indonesian Sea
39. North Australian Shelf
40. Northeast Australian Shelf
41. East-Central Australian Shelf

42. Southeast Australian Shelf
43. Southwest Australian Shelf
44. West-Central Australian Shelf
45. Northwest Australian Shelf
46. New Zealand Shelf
47. East China Sea
48. Yellow Sea
49. Kuroshio Current
50. Sea of Japan/East Sea
51. Oyashio Current
52. Sea of Okhotsk
53. West Bering Sea
54. Northern Bering-Chukchi Seas

55. Beaufort Sea
56. East Siberian Sea
57. Laptev Sea
58. Kara Sea
59. Iceland Shelf and Sea
60. Faroe Plateau
61. Antarctic
62. Black Sea
63. Hudson Bay Complex
64. Central Arctic Ocean
65. Aleutian Islands
66. Canadian High Arctic-North Greenland

Figure 1 – Large Marine Ecosystems of the World. Source: NOAA; University of Rhode Island

Brazilian matrix of fishing license by fishing methods and gears (Interministerial Normative Instruction nº 10/2011, establishes an institutional matrix in charge of the management of fisheries in Brazil).

Main fishing authorization (fishing licenses)	Fishing method or gear	Set of different fishing arrangements – process or form of extraction, collection or capture of fishery resources carried out in accordance with the structural and operational characteristics of the fishing vessel and its equipment, as well as the fishing gears employed in the fishing operations – which uses similar physical and operating characteristics.
	Target species	Species of commercial interest, object of the fishing license, on which fishing effort is directed.
	By-catch (predictable)	Group of species subject to marketing, caught naturally during fishing operations of the target species, which coexist in the same area of occurrence, substrate or depth, whose capture cannot be avoided, subject to normative defined in specific regulation.
	Incidental catch	Group of species not suitable to marketing, incidentally caught during fishing operations of the target species, which coexist in the same area of occurrence, substrate or depth, whose capture should be avoided because they are protected by specific legislation or international agreements which, when captured, must be released alive or discarded in the fishing area or landed for research purposes when authorized by specific normative and reported in logbooks.
Secondary species (complementary)		Group of species of commercial interest, other than the target species, which fishing is permitted by a complementary fishing license and can occur during the target species fishing season, as well as during closed seasons, subject to normative defined in specific regulation.
Area of fishing operation		Area corresponding to the naturally occurrence of the target species, or defined in regulations, specified in the fishing license, subject to the restriction of fishing areas defined in specific legislation.

The license system identified 60 fisheries and/or fishing gear within six fishing methods along Brazilian coast, namely: Hook & Line (14 fisheries or fishing gears); Gillnets (12 fisheries or fishing gears); Trawl nets (14 fisheries or fishing gears); Surrounding nets (5 fisheries or fishing gears); Traps (8 fisheries or fishing gears); and Others - multigears and multispecies fisheries (7 fisheries or fishing gears)

5. BASIC INFORMATION ON THE SHRIMP TRAWL FISHERY IN BRAZIL

As emphasized in a Draft of National Project Design Report for Brazil prepared by Hazin (2014) to the Sustainable Management of Bycatch in Latin America and Caribbean Trawl Fisheries (Global Environment Facility- GEF-REBYC-II LAC) Project, before addressing any analysis on bycatch in the Brazilian context, or specific issues, it is necessary to consider the large dimensions of the country, and the multitude of fishing gears and methods used. A summary of the shrimp trawling fishery activity and an imperative analysis will be given below.

✓ In spite of the rather numerous normative instruments applicable to the shrimp trawling fishery in Brazil, in different regions (north, northeast and south/ southeast), only the mandatory use of TEDs, adopted universally in 1997, is directly related to the reduction of bycatch, specifically for turtles. Its effective adoption, however, has been minimal in many instances and the actual extension of its application is unknown, but some reports suggest a very high level of non-compliance (Medeiros *et al.*, 2013);

✓ The minimum mesh size adopted, in general, 28 mm for trawling in areas distant from shore and 20 mm for areas closer to estuaries, aims more at reducing the catch of juvenile shrimp than of other species, although it is considered to be rather ineffective for both (IBAMA, 2011).

✓ Minimum distance from shore, since the closer to the shore the higher the catch of smaller shrimps and juvenile teleosts. This is also the reason why trawling with powered boats inside estuarine areas is forbidden throughout the entire coast. The distance from shore from which shrimp trawling is allowed, however, changes widely, from area and State, ranging from 300 m to 5 nm.

✓ Time-area closures adopted vary for different species and different regions, and although a powerful management measure with proposed actions for implementation, are not directly related to bycatch. Their main objective is to reduce fishing mortality during the peak of reproduction and recruitment of the target species (shrimps).

Although the potential utilization of the bycatch discarded by the shrimp trawling fishery in Brazil has been addressed by some studies (IBAMA, 2011), very little research has been done on the subject. One of the reasons might have been the prioritization of bycatch reduction in scientific studies instead of its utilization, fearing that making it more valuable may result in an increase in catches and, to the very least, in a lower incentive to reduce it.

The main barriers for the sustainable bycatch management and reduction of discards in the shrimp trawl fishery in Brazil are:

a) The lack of an Management Control System (MCS), including a systematic collection of data and observers on board, that allow for a proper evaluation and monitoring of catch and effort data, including bycatch;

b) A reduced number of research initiatives aiming at fishing methods and strategies to reduce the bycatch and its mortality in the shrimp trawl fishery;

c) The lack of information to subsidize the elaboration of a specific and comprehensive management plan for the reduction of bycatch in the shrimp trawl fishery, with a national scope and a regional implementation strategy, including its human dimensions;

d) The lack of a management system that allows for adaptive co-management and research aiming at developing such systems;

e) The low level of integration between the Ministry of Fisheries and Aquaculture and the Ministry of the Environment, the entities responsible for the jointly institutional management of the fisheries and aquaculture sector in Brazil; and

f) The low level of awareness among stakeholders regarding the need to properly manage the use of fisheries resources and the negative consequences of overfishing.

Anyhow, considering trawling a foremost concern for the management of bycatch and reduction of discards, Conolly (1992) described that fin-fish trawling in the South of Brazil is also a major activity responsible for significant quantities of bycatch.

6. BYCATCH & DISCARD MONITORING MEASURES USED BY LARGE MARINE ECOSYSTEM, COUNTRY, FISHERIES AND FISHING METHODS.

Monitoring and management measures on bycatch and discard reduction in the LAC Region were analysed according to information available in grey literature and in each country and each one of LMEs identified, namely: Gulf of Mexico Large Marine Ecosystem - Mexican Fisheries; Pacific Central-American Large Marine Ecosystem - Mexican Fisheries; Caribbean Large Marine Ecosystem - Barbados Fisheries; Caribbean Large Marine Ecosystem - Costa Rican Fisheries; Caribbean Large Marine Ecosystem – Colombian Caribbean Sea Fisheries; Caribbean Large Marine Ecosystem – Puerto Rican Fisheries; Humboldt Current Large Marine Ecosystem – Colombian Fisheries; Humboldt Current Large Marine Ecosystem – Peruvian Fisheries; Patagonian Shelf Large Marine Ecosystem - Uruguayan tuna fishery; Patagonian Shelf Large Marine Ecosystem - Argentinean

Coastal Fisheries; South Brazil Shelf Large Marine Ecosystem – Southeast and south Regions of Brazil (From Espírito Santo to Rio Grande do Sul States); East Brazil Shelf Large Marine Ecosystem – Northeast Region of Brazil (From Piauí to Bahia States); and North Brazil Shelf Large Marine Ecosystem - Northern Brazilian Fisheries.

An example of the collected information is shown in the template below for the South Brazil Shelf Large Marine Ecosystem – Southeast and south Regions of Brazil (From Espírito Santo to Rio Grande do Sul States).

Fishing method	1. Hook & Line: Long lines, Jigging, Trolling, Pole lines. 2. Hook & Line: Long lines, Jigging, Trolling, Pole lines. 3. Hook & Line: Long lines, Jigging, Trolling, Pole lines. 4. Trawl nets 5. Trawl nets 6. Gillnet 7. Surrounding nets
Identified fishing gear	1. Long-line: Extremely long lines that can be anchored or drifting, with numerous baited hooks (SEAFISH, 2005). 2. Pole line 3. Bottom long-line: extremely long lines that can be anchored or drifting, with numerous baited hooks (SEAFISH, 2005). 4. Otter trawl: Trawl towed on the seabed, held open by a pair of otter boards (trawl doors). It is usually a much larger net than a beam trawl. (SEAFISH, 2005). 5. Outriggers attached amidships to tow twin, hand deployed-and-retrieved trawls. 6. Coastal Gillnet: Sheets of thin netting anchored in the water to catch fish by enmeshing or entangling them. (SEAFISH, 2005). 7. Purse seine: A large net used to surround a shoal of pelagic fish, the bottom of which is then drawn together to enclose them. (SEAFISH, 2005)
Source of information	1, 2, 3, 6 & 7. BRAZIL. (2011) Interministerial Normative Instruction nº 10/2011, establishes an institutional matrix in charge of the management of fisheries in Brazil. 4. Duarte, 2013. 5. Silva et al., 2011; Diegues, 2006; Andriguetto-Filho et al., 2009
Target species	1. Dolphin fish (*Coryphaena hippurus*) 2. Skipjack (*Katsuwonus pelamis*) 3. Groupers (Serranidae) 4. Pink Shrimp (*Farfantepenaeus brasiliensis*, *Farfantepenaeus subtilis*), Seabob Shrimp (*Xiphopenaeus kroyeri*) & White Shrimp (*Litopenaeus schmitti*). 5. Seabob Shrimp (*Xiphopenaeus kroyeri*). 6. Mullet (*Mugil platanus* or *Mugil liza*), Anchovy (*Pomatomus saltatrix*), Mackerel (*Scomberomorus brasiliensis*). 7. Sardinha verdadeira (*Sardinella brasiliensis*)
Main bycatch group of species	1. Tuna like fishes (mackerels, skipjacks, billfishes, etc.), shark and rays. 2. Tuna like fishes (mackerels, dolphin fish, albacores, billfishes, etc.), shark. 3. Snappers, catfishes, weakfishes. 4. Juveniles of finfish species, sharks & rays. 5. Teleosts (e.g. sciaenids) and brachyurids (typically *Callinectes* spp.). 6. Sharks, Coastal pelagic finfishes. 7. Coastal small pelagic finfishes species, skipjacks.
Incidental catches (protected & endangered group of species)	1. Billfishes, sharks, seabirds and turtles. 2. Nill 3. Giant grouper. 4. Giant groupers, Dolphin, Turtles, Sharks & Rays. Off southern Brazil, for instance, preliminary results obtained onboard industrial double-rig trawlers indicate a catch rate of one turtle every ten fishing days. 5. Hidden angel shark (*Squatina occulta*) 6. Turtles, Dolphins, Whales. 7. Nill

Monitoring and management measures used	✓ Mandatory to use VMS system for boats larger than 15 m LOA and/or 50 GWT, for both fleets.
	✓ Mandatory to deliver logbooks to administration, which includes specific fields for recording bycatch, along with data on catches of targeted species and fishing effort, for both fleets.
	✓ Establishment of a program to combat illegal, unregulated and unreported fishing (IUU fishing still a challenge to be tackled and catches, as well as bycatch and discards, misreporting prevails), for both fleets.
	✓ Mandatory use of Turtle Excluder Devices (TEDs) for the shrimp trawl fishery.
	✓ The minimum mesh size adopted, in general, 28 mm for trawling in areas distant from shore and 20 mm for areas closer to estuaries, aims more at reducing the catch of juvenile shrimp than of other species, although it is considered to be rather ineffective for both, for the shrimp trawl fishery.
	✓ The results obtained so far have demonstrated that several of the BRDs tested significantly reduced bycatch in the shrimp trawl fishery, without significantly impacting the catches of the target species. Their introduction as a management tool in the fishery from a top-down approach will very likely fail.
	✓ In the lobster fishery it is allowed to retain catch of specimens 2mm smaller than the minimum catch size, that correspond to 2% of the total catch. Even if not alive, smaller specimens and volume of illegal catches greater than 2% must be discarded.
	✓ Mandatory presence of scientific observers in 100% of the leased fleet and 20% of the national fleet, for the tuna fishery;
	✓ Prohibitied to commercialize white and black marlin, but the amount should be reported and donated for the tuna fishery.
	✓ Unlike many other artisanal penaeid-trawl fisheries (e.g. Eayrs et al., 2007), southern Brazilian canoe trawlers discard all of their bycatch. All bycatch is considered a nuisance in terms of sorting catches, although the brachyurids are of most concern to canoe trawlers since they damage and reduce the quality of *X. kroyeri.*
	✓ Establishment of time/area closure.
	✓ Bycatch reduction devices (BRD) are technical modifications installed in trawl nets in order to avoid or to reduce unwanted fishing mortality and are being tested.

7. REMARKS AND CHALLENGES

Challenges faced by LAC Region countries can be summarized as follows:

✓ The Amazon Hydrographical Basin (Inland fisheries). High level of waste and discard and misreporting of the catches leads to lack of appropriate management measures and food insecurity, due to the high dependency on aquatic resources.

✓ Post-harvest losses. Poor handling, storage and processing, causes damage and fish run-out, and consequently low quality. It seems that post-harvest wastage is greater than any other discard issues.

✓ Technological improvement of gears and other devices. BRDs tested reduced bycatch in the shrimp trawl fishery without greatly impacting the catches of the target species, but as a management tool from a top-down approach, it will likely fail. To be successful, innovative management strategies, such as adaptive co-management, are needed.

✓ It seems that bycatch is increasing, but discards decreasing, due to overexploitation of the target species, or group of species (e.g. Shrimp).

✓ In most cases in LAC Region countries, the fishery management objective is to maximize catches, irrespective of the species composition. There are no direct regulations on discards.

✓ National/Regional fisheries data collection: fisheries statistics still a challenge for developing countries.

- ✓ Differences in methodologies, a diverse political system, and the existing legal and institutional frameworks, at regional, national and local levels, present challenges to properly access fisheries data, making it even harder to assess.
- ✓ Important to have as similar a definition and methodology as possible between countries and regions.

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Compilation and review of information on the level of discarding in some trawl fisheries in Moroccan waters

A. Najd, J. Bensbai, A. Dridi, N. Elouamari, A. Bomaaz and K. Manchih

In order to assure the monitoring of discards of all fleets operating in Moroccan water, INRH has undertaken a study with the objective to estimate the discards of some fleets operating in Moroccan water. Several scientists have boarded vessels to survey their discards.

This study is based on data from logbooks and an on-board observer program of select Moroccan trawlers (Demersal fishery in Mediterranean Sea, Cephalopod freezer fishery in Atlantic). The study also used data from foreign trawlers (EU demersal and small pelagic fishery, Russian small pelagic fishery).

The analysis shows that the demersal fishery that uses bottom trawl has almost the same discards ratio (around thirty). Moreover, pelagic fisheries that use pelagic trawl have a 1% discards ratio; this ratio is also very important considering the importance of catch of those fleets.

The results also show that the main drivers of discards are regulation dependent (quota achieved, prohibited, achieved percentage of bycatch, species individuals with lower market size) and commercialization (species with no commercial value, maximization of the value of the catch). Discarding rate and discarded species vary between fleets and areas.

When quantifying discards, some difficulties were encountered, such as sampling and extrapolation, consequently making the effective use of results challenging. Because of this, the development of accurate sampling methodologies is necessary.

Annex 4 – List of potential sources of data

Europe:
- EC data base (JRC): JRC Data Dissemination Tool (2002-2013)
- EU (non Mediterranean): http://datacollection.jrc.ec.europa.eu/dd/effort/graphs
- Mediterranean EU: http://datacollection.jrc.ec.europa.eu/dd/med/graphs
- European Commission Studies in the Field of the Common Fisheries Policy and Maritime Affairs Lot 4: Impact Assessment Studies related to the CFP June 2011 Impact Assessment of Discard Reducing Policies DRAFT FINAL Report
- *Member State authorities responsible for data collection under DCR/DCF –details available from Europa website:* http://datacollection.jrc.ec.europa.eu/national-correspondent

RACs

Denmark	Baltic Sea RAC	www.bsrac.org
Scotland (UK)	North Sea RAC	www.nsrac.org
Ireland	North western waters RAC	www.nwwrac.org
France	South western waters RAC	www.ccr-s.eu
Netherlands	Pelagic RAC	www.pelagic-rac.org
Spain	Long Distance Fleet RAC	www.ldrac.eu

	Contacts
Ongoing observer programs	EU 1. EU Data Collection Framework - Collection of Biological variables: Discards.
Existing compilations	MEDITERRANEAN 1. REVIEW OF EXISTING KNOWLEDGE ON FISHERIES BY-CATCHES AND DISCARDS IN THE GFCM AREA. GFCM:SAC14/2012/Dma.6
EU Reports	Impact Assessment of Discard Reducing Policies. EC Draft Final Report 2011.
Scientific projects	1. BADMINTON - Bycatch And Discards in European Fisheries: Indicators, Trends and Mitigation Measures (Contact person: V. Vassilopoulou: celia@hcmr.gr) 2. DISCATCH PROJECT. Pilot project on catch and discard composition including solutions for limitation and possible elimination of unwanted by-catches in trawl net fisheries in the Mediterranean (Contact person: A. Sala; a.sala@ismar.cnr.it) 3. LANDMED Project. Assessing the main implications of the implementation of the landing obligations, including the de minimis provisions in the concerned small pelagic fisheries in the Mediterranean. (Contact person: P. Sartor; psartor@cibm.it). 4. SIMBAD. SELECTION AT SEA TO REDUCE DISCARDS. The reform of the Common Fisheries Policy includes a prohibition of fishing discards. Given the complexity of its implementation, SWW RAC's members have expressed the desire to be proactive in the search for solutions to this problem. They would like to become involved in work to improve knowledge relating to each fleet in order to put forward appropriate and operational reduction strategies. (Contact: Yohan Weiller; yweiller@ccr-s.eu

Modelled info	1. BADMINTON - Bycatch And Discards in European Fisheries: Indicators, Trends and Mitigation Measures (Contact person: V. Vassilopoulou: celia@hcmr.gr) *Spatio-temporal identification of discarding hotspots through GAMMs*
Scientific Surveys	MEDITERRANEAN 1. MEDITS - Mediterranean Trawl Survey targeting demersal species (1994 - today) 2. MEDIAS - Mediterranean Acoustic Survey targeting small pelagics (2002 - today)

RFMOs:

CCAMLR - Commission on the Conservation of Antarctic Marine Living Resources
Mr. Andrew Wright, Executive Secretary
P O Box 213
North Hobart
Tasmania 7002 AUSTRALIA
E-mail: ccamlr@ccamlr.org; andrew_wright@ccamlr.org

CCSBT - Commission for the Conservation of Southern Bluefin Tuna
Mr. Robert Kennedy, Executive Secretary
PO Box 37
Deakin West
ACT 2600 AUSTRALIA
E-mail: sec@ccsbt.org; rkennedy@ccsbt.org

GFCM - General Fisheries Commission for the Mediterranean Secretariat
Mr. Abdellah Srour, Executive Secretary
FAO
Viale delle Terme di Caracalla
Rome 00153 ITALY
E-mail: abdellah.srour@fao.org

IATTC - Inter-American Tropical Tuna Commission
Dr. Guillermo A. Compean, Director
8604 La Jolla Shores Drive
La Jolla, California, 92037-1508 USA
E-mail: gcompean@iattc.org
Richard Deriso (chief scientist) Email: rderiso@iattc.org

ICCAT - International Commission for the Conservation of Atlantic Tunas
Mr. Driss Meski
Calle Corazon de Maria, 8, Sixth Floor
28002 Madrid SPAIN
E-mail: driss.meski@iccat.int

IOTC - Indian Ocean Tuna Commission
Dr. Alejandro Anganuzzi, Executive Secretary
PO Box 1011, Victoria SEYCHELLES
E-mail: Rondolph Payet: rp@iotc.org

IPHC – International Pacific Halibut Commission
www.iphc.int

NAFO - Northwest Atlantic Fisheries Organization
Dr. Vladimir Shibanov, Executive Secretary
P.O. Box 638
Dartmouth - Nova Scotia B2Y 3Y9 CANADA
E-mail: info@nafo.int; vshibanov@nafo.int
Fred Kingston. Email: llefort@nafo.int. tel: +1- 902) 468 5590 202

NASCO - North Atlantic Salmon Conservation Organization
Dr. Malcolm Windsor, Secretary
11, Rutland Square
Edinburgh EH 1 2AS UNITED KINGDOM
E-mail: hq@nasco.int

NEAFC - North East Atlantic Fisheries Commission
Dr. Kjartan Hoydal, Secretary
22, Berners Street
London W1T 3DY UNITED KINGDOM
E-mail: kjartan@neafc.org

NPAFC - North Pacific Anadromous Fish Commission
Mr. Vladimir Fedorenko, Executive Secretary
889 West Pender Street, Suite 502
Vancouver, British Columbia, V6C 3B2 CANADA
E-mail: secretariat@npafc.org; vladf@npafc.org

RECOFI - Regional Commission for Fisheries
Mr. Mona Hafez, Secretary
Food and Agriculture Organization of the United Nations
Regional Office for the Near East (RNE)
P.O. Box 2223, Cairo EGYPT
E-mail: RNE-KIMS@fao.org; FAO-RNE@fao.org; mona.hafez@fao.org

SEAFO - Southeast Atlantic Fisheries Organization
Dr. Ben van Zyl, Executive Secretary
133 Nangolo Mbumba Drive, Savvas Building
P.O. Box 4296, Walvis Bay NAMIBIA
E-mail: info@seafo.org; bvanzyl@seafo.org

SPRFMO – South Pacific Regional Fisheries Management Organization
Dr. Johanne Fischer
Email: jfischer@sprfmo.int

WCPFC - Western and Central Pacific Fisheries Commission
Professor Glenn Hurry, Executive Director
Kaselehlie Street, PO Box 2356
Kolonia, Pohnepi State 96941
FEDERATED STATES OF MICRONESIA

E-mail: wcpfc@wcpfc.int; glenn.hurry@wcpfc.int
sungkwon.soh@wcpfc.int (data coordinator)

NGOs / IGOs:

- *WWF*: Alfred Schumm - SFI Leader: alfred.schumm@wwf.de / Daniel Suddaby: SFI Deputy Leader: daniel.suddaby@wwf.panda.org / David Schorr: SFI - Manager, Fisheries Governance: david.schorr@wwfus.org
- *Pew*: Joe Zelasney jzelasney@pewtrusts.org
- *Oceana*: Vanya Vulperhorst. Email: vvulperhorst@oceana.org. www.ocean.org/our-campaings/bycatch/campaign
- Also note involvement of WWF and SFP (https://www.sustainablefish.org/) in FIPs - potential useful source of information. Poseidon has been involved in many FIPs, esp in Asia/Pacific region
- IUCN (www.iucn.org) http://www.iucn.org/about/union/commissions/cem/
- CEM – Commission on Ecosystem Management
- SAVE FOOD Initiative (www.save-food.org)
- FAO, UNEP, Messe Düsseldorf Group
- Lenfest Ocean Program (www.lenfestocean.org)

GEF/LME projects of potential interest:

- *South West Indian Ocean Fisheries Project* archives : www.swiofc.org
- *BOBLME*: Rudi Hermes and Chris O'Brien
- *FAO tuna ABNJ project*: Alejandro Anganuzzi, Rome/FAO HQ: alejandro.anganuzzi@gmail.com
- *GEF International Waters Team*:
    - Astrid Hillers, acting International Waters Cluster Coordinator, Sr. Environmental Specialist, ahillers@thegef.org
    - Nicole Glineur, Sr. Environmental Specialist, nglineur@thegef.org
    - Steffen Hansen, Jr. Program Officer, shansen@thegef.org
    - Christian Severin, Sr. Environmental Specialist, cseverin@thegef.org
    - Leah Karrer, Sr. Environmental Specialist, lkarrer@thegef.org

INLAND FISHERIES:

Amazon Cooperation Treaty Organization – ACTO (www.octa.info/portal)

Potential Russian Contacts:

Heather Brandon, WWF, conservation issues in US and Russia: https://www.linkedin.com/pub/heather-brandon/5/426/984

Pramod. Ganapathiraju, MCS & Fisheries Consultant, IUU Risk Intelligence, https://ca.linkedin.com/pub/pramod-ganapathiraju/14/220/689

Alexei Kraikovski, Fulbright Fellow at University of Hawaii at Manoa,
https://ru.linkedin.com/pub/alexei-kraikovski/2a/632/54b

Pavel Mikheev, head of the laboratory of resources - State Research Institute on Lake & River Fisheries, https://ru.linkedin.com/pub/pavel-mikheev/51/4b4/567

Seafood certification programmes
(these do not provide discard estimates but are a good source of national/regional data sources that may not be generally accessible)

Global Trust: MSC and FAO certification body
Contact : Vito Romney/David Garforth
http://www.gtcert.com/fao-based/
http://www.gtcert.com/marine-stewardship-council-(msc)-certification/

Sustainable Fisheries Partnership
Contact: Doug Beveridge
http://www.sustainablefish.org/fisheries-improvement

Marine Stewardship Council
Contact: David Agnew
https://www.msc.org/track-a-fishery/fisheries-in-the-program/certified

SCS Global Services
Contact: Siân Morgan
http://www.scsglobalservices.com/sustainable-seafood-certification

Other sources:
- List of sources at Kelleher, page 111
- Sea Around Us Project
- MSC and other ecolabels (www.msc.org) Website has all full assessment reports, and details for all contacts of staff - Pre-assessment reports not made public and are confidential but Poseidon has completed many and can review
- Ongoing observer programs
- US Bycatch Report
- LME
- OECD
- FAO list of landings (by nation)
- Great Lakes Fisheries Commission
- RFBs (inland RFBs, examples: lake Victoria) – see FAO website
- Professional Networks (Linkedin, Association for Professional Observers, International Association on Marine Science and Information Centers)
- Fishermen associations
- Modelled information
- ICES Intercatch

International conventions and agreements:
- Caspian Sea
- CITES
- ASCOBANS/ACCOBAMS

- International conventions and agreements:
- Caspian Sea
- CITES
- North Atlantic Marine Mammal Commission
- Bird Life International
- Agreement on the Conservation of Albatross and Petrels
- International Convention for the Conservation of the Caribbean Turtles

Other potential sources of information will be national and regional resolutions that contribute to quantify the impact of fisheries discard, as a sub-set of bycatch.

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Draft Concept note for the Project

Global Assessment of Fisheries Discards

1. Background - Why we need a global assessment of discards

FAO anticipates that global food production must increase 60% by 2050 to meet the demands of the growing world population. Yet, more than one third of the food produced today is lost or wasted. Bycatch and discards represent significant food loss and wastage in the world's fisheries. Food security problems are increasing in many developing, protein-poor countries, and especially in those countries whose main source of protein is seafood. Benchmarking and reporting on fisheries bycatch and discards is a vital step to the improved utilization of seafood resources and reducing wastage, and the more effective management of fisheries resources. As a consequence of these issues, there are a variety of UN/FAO resolutions and mandates requiring the consideration of food security and poverty reduction when managing the world's fisheries and their discards.

FAO previously commissioned two global assessments of fisheries discards. The first (in 1994) provided a yearly mean global estimate of 27 million tonnes of discards (a discard ratio of approximately 35%). A decade later, an update estimated global average yearly discards as 7.3 million tonnes (a discard ratio of approximately 8%). Although the estimates were not strictly comparable, this suggested a decline in discarding during the 10 year period. It is now 10 years since the previous report, and timely and prudent to provide an updated estimate to assess how the world is performing in reducing discards and seafood wastage and provide further guidance on how countries can reduce waste in fisheries.

In May 2015, an expert workshop on the "Methodology to assess and quantify the extent and impact of fisheries bycatch and discards" was held in Casablanca and involved 14 experts from most of the world's continents. This workshop determined the scope, approach, methodology, process and timeline for a project that will provide an updated global discard report.

2. Overall goals of the project

In providing an updated global assessment of fisheries discards, this project will contribute to the following overarching goals:
- Improved sustainability of the world's fisheries
- Reduced wastage of seafood resources
- Improved food security in developing countries that rely on seafood as a major source of protein

3. Outputs of the project

The project will
- Assess the current status and trends in global discards
- Address key social, economic and environmental issues associated with bycatch and discards
- Identify and communicate best practices (methods) for the estimation, management and reduction of discards and associated waste

- Contribute to a cost effective decadal mechanism to monitor and report on global discards and advances in waste reduction in fisheries

4. Process and timeline

The project will be done via a series of phases.

Phase 1: (from mid-2015 to early 2016) will involve the identification of available sources of data on discards. This will build on the substantial list developed during the Casablanca workshop. Readily available data (e.g. from the US Bycatch Report, EU Observer programs, RFMO programs) will be compiled into a relational database. During phase 1 the project team will search for, obtain and/or derive estimates from other countries and regions in close collaboration with Regional Fisheries Bodies, which are expected to take 'ownership' of regional discard information.

Phase 2: During 2016, the team will address key social, economic and environmental implications of bycatch and discards such as unaccounted fishing mortalities, slipping mortalities, ghost fishing, retained low-value fish for the fishmeal industry, shark finning, and the discard of offal. Specific attention will be devoted to estimates of mortalities of Endangered, Threatened and Protected species.

Phase 3: The final stage (in 2017) will be the preparation of the final report, publications and media concerning the project, dissemination of lessons and best practices and preparation of information for COFI and UN Oceans.

5. Participants

A core team of FAO staff, consultants and regional FAO staff will be formed to execute the project. The team will establish regional/national focal points and incorporate input from the many expert networks around the world who work in this field. The team will also engage with national governments, RFMOs, RFBs and others stakeholders.

6. Communication and Dissemination Strategy

It is anticipated to formally launch the project at the 20th anniversary of the CCRF at CONXEMAR (in Vigo, Spain, in October 2015) and deliver a progress report at a side event at COFI in 2016. A dedicated session on the project is planning to be held at the 7th World Fisheries Congress in Busan, Korea in May, 2016.

The project will produce a variety of deliverables including the final FAO report, input to the UN Oceans process, advice on management of discards and bycatch magazine articles, infographics, media releases, a Technology Engineering and Design (TED talk), Google map overviews, as well as outputs in a variety of professional networking fora and social media (e.g. LinkedIn, Facebook). The project will also foster increased awareness of discard issues in developing countries and provide lessons on waste reduction and improved food security.

7. Financing

It is anticipated that, in total, the project will cost USD 500,000 (in cash) as well as substantial in-kind contributions from project partners and other stakeholders. FAO is committed to providing USD 150,000, leaving a financing gap of USD 350,000 to be raised from other potential funders.

Summary Concept Note

Project title: Assessment of discards and discard reduction in world fisheries.
Goal: To reduce wastage in fisheries.
Specific objectives: 1. To assess the scale and trends in global discards. 2. To analyse the priority social, economic and environmental issues associated with discards. 3. To describe lessons and best practises in the reduction of discards, associated waste and losses of endangered and protected species.
Rationale: About 8% of the global marine fish catch is discarded – this is unwanted fish dumped at sea. Around 8 million tons of discards constitute a major waste of natural resources with profound implications for sustainability of fisheries, for coastal livelihoods and for food security. A new estimate of the scale of discards will complement previous 2005 and 1994 estimates. The 2005 discard assessment is among the most cited FAO fisheries publications and is considered to have been instrumental in discard reduction. The well-recognised ethical and scientific rationale for reduction of discards need to be complemented by a social and economic rationale for reduction; by assessment of the trade-offs required; and by synthesis of lessons and best practices, in order to establish robust pathways to reduction of discards and at sea waste reduction in the diversity of fisheries.
Coordinating agency: FAO as part of its mandate provided by UNGA and Rio 'The Future we Want' – to *"manage discards and bycatch"* in fisheries.
Proposed cooperating agencies (to be confirmed): Approximately 20 Regional Fisheries Management Organisations managing international fisheries; up to 15 Regional Fisheries Bodies that coordinate regional fisheries activities; EC, DG Mare, OECD Committee on Fisheries; ASEAN Secretariat; international bodies responsible for conservation of aquatic biodiversity, endangered and protected aquatic species and concerned NGOs (MSC, ISSF, others).
Proposed supporting agencies: FAO, Norway (Ministry of Foreign Affairs), and in kind support from numerous government fisheries agencies, including NMFS/NOAA (USA), The Marine Institute (Ireland), the Institute of Marine Research (Norway), EU Joint Research Centre. Others (to be confirmed): the GEF, France (AFD), IIFET, SEAFDEC, sustainable fisheries ecolabelling bodies such as the MSC, scientific organisations, NGOs, IFFO, ISSF,WB Global Partnership for Oceans, TRAFFIC/WILD sharkfin.
Outputs: 1. Flagship report through the FAO Committee on Fisheries to the UN Oceans providing a quantification of global discards and trends; analysis of priority issues; and recommendations on reduction of harvesting waste in fisheries. 2. A publicly available global fishery-by-fishery discard information base. 3. Dissemination of conclusions and recommendations to decision-makers and preparation of 'next steps' in management of discards and bycatch with a particular focus on developing country fisheries.
Estimated (cash) costs: US$ 450,000 excluding in-kind contributions. **Secured (cash) financing**: US$ 100,000 (May 2015)
Timescale and phasing: Completion: July 2017. Phase I (2015 to mid-2016): (a) Enhancement of existing (2005) methodology; (b) stakeholder dialogues and establishment of expert network and data depositary; (c) compilation and analysis of existing national and regional discard assessments with emphasis on major fisheries; (d) case studies

on priority issues, including on food security implications; (d) interim report to FAO Committee on Fisheries in mid-2016.

Phase II (mid 2016- early 2017): (a) Completion of remaining national and regional discard analyses; (b) completion and synthesis of social, economic and environmental case studies; (c) preparation of lessons and best practices portfolio and synthesis of conclusions.

Phase III (early – mid-2017): (a) Dissemination, reviews and stakeholder dialogues on draft report; (b) delivery of available syntheses to cooperating regional fisheries agencies and national agencies and cooperating partners; (c) Presentation of final report at COFI 2018, opening of public access to the discard knowledge base, and preparation of follow-up to COFI decisions.

Execution: FAO will have primary responsibility for delivery of the outputs, coordination of the activities and management of 'cash' contributions through a special FAO account. A core team of FAO staff and external experts will undertake the compilation and analysis of discard information, synthesis of case studies, preparation of reports and design and execution of the dissemination strategy. Key cooperating agencies will provide an expert reference group with an external (non-FAO chair). Brief quarterly progress reports will be provided to a small advisory group of major 'cash' and in kind contributors and an on-line forum established.