Session 1. Why monitor fisheries and what to monitor?

Leader: Steve Kennelly

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

Oral Presentations - Extended Abstracts

Chilean approach to understand and mitigate bycatch in fisheries

Luis Cocas

Under Secretariat for Fisheries and Aquaculture, Government of Chile

Introduction

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

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

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

A. Improved regulation and research

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

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

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

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

Further exemptions to the bycatch ban will apply as long as the following requirements are met: (i) research programs are completed and bycatch mitigation plans are established, (ii) sufficient technical background has been collected according to the protocols established by the research programs, (iii) the monitoring program continues to run, (iv) a global catch quota, which accounts for discards, has been set for the target species, (v) target and non-

target species including incidental catch are subjected to mitigation plans, and (vi) discarding does not affect the conservation of the target species. Finally, there were restrictions on the use of previously discarded catches that will be lifted or reviewed within the remits of the mitigation plans.

B. Progressive reduction through binding mitigation plans

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

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

C. Compliance with the bycatch law and mitigation plans

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

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

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

Discussion

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

monitoring will change fishing practices, which will probably result in a change in fishing patterns and a reduction in unwanted catch.

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

Miguel Machete and Helder Silva

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

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

within the EU fisheries policy as well as the data collection framework (national program). The small scale net fishery for small pelagics is the only one allowed to catch those species and has regional restrictions for target species daily landings (eg: a maximum of 400 kgs of mackerel can be landed per day).

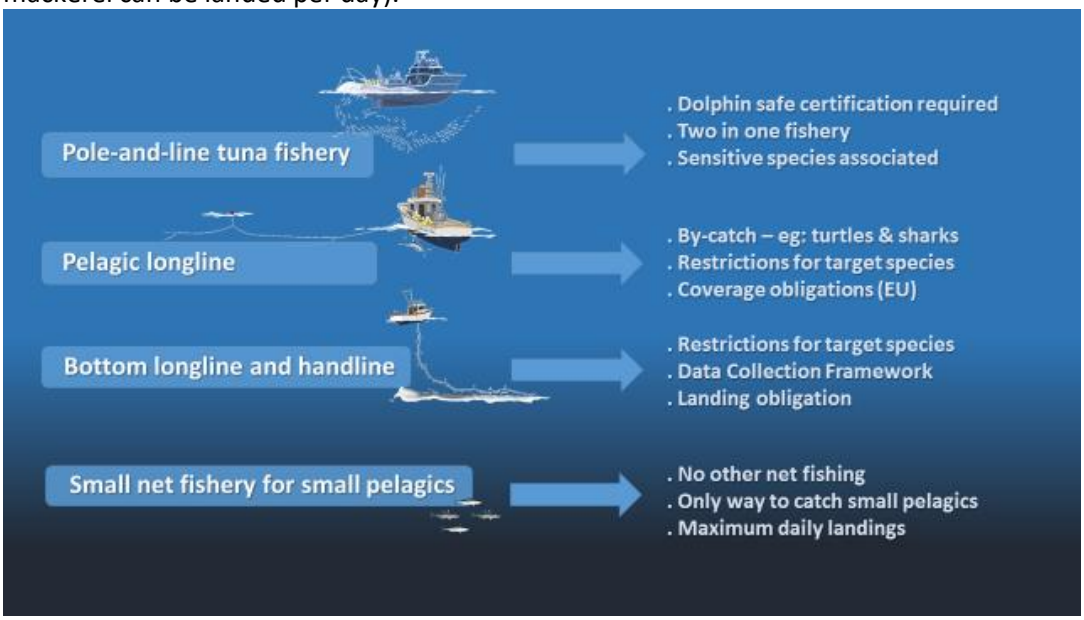

Figure1 – Main fisheries in the Azores and specific management issues associated (Pictures © Fishpics® & IMAR-DOP, Uaç)

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

The POPA observers not only collect information about the fisheries (fishing gears, fishing operation, target species, by-catch) but also about associated species such as cetaceans, sea birds and turtles, marine litter and abiotic parameters. The Eco labelling certifications (dolphin safe and friend of the sea) achieved by the tuna fishery in the Azores were supported by POPA and all the produced scientific results brought essential knowledge to the north Atlantic area wherever it was trough reports for intergovernmental organizations (eg: ICCAT) or spacial information for global on-line databases (eg: OBISeamap). POPA data also allowed researchers and decision makers to face the emerging multitude of demands within the EU Fishery Policy: the Data collection framework directive (National Program)

strongly targets long line and hand line activities and the by-catch landing obligation is eminent. For instance only recently an exhaustive overview of the discards issue in the main Azorean fisheries was accomplished including non-fish sensitive fishes such as corals and sponges. Spatial distribution of those taxa deep water colonies was also analysed trough data collection and live corals were brought by the observers to test recovery and later reallocation in natural habitats. Other EU diplomas such as the Marine Strategy Framework Directive (MSFD) are focused on other marine issues: within the MSFD scope Popa observers start to collect data about marine litter in 2015 so the regional government could be able to share with EU information regarding spacial distribution of the different types of marine litter in the surface of the Azorean EEZ. Moreover the Program and the observers team have also a major role in sensitizing fishermen for important ecological aspects such as marine pollution as well as establishing the bridge between them and science/governance players. To enhance those bounds and to reinforce fishermen confidence and knowledge on the Programs work the executive commission produces an annual publication for fishermen which includes geolocated maps from the previous year with tuna and live bait catches per month, so they can evaluated which were the most productive areas in the past season.

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

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

Christopher Milley

Dalhousie University, Canada

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

The struggle of Indigenous nations for recognition of their territorial rights is well understood. Many Indigenous nations have used State legal systems and negotiation

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

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

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

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

Open Discussion Session

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Poster Presentations – Extended Abstracts

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

Ryan Shama

NOAA Fisheries Northwest Fisheries Science Center, Fisheries Resource Analysis & Monitoring Division, West Coast Groundfish Observer Program

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

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

The U.S. West Coast groundfish fishery is now in the midst of a truly remarkable success story. Of the 10 species deemed overfished between 1999 and 2010, all but 2 have been declared rebuilt, as of 2017. Observers played a crucial role in this recovery by providing

accurate accounts of at-sea discards, a major piece of the puzzle which had previously been unavailable to fishery managers. Along with at-sea discard estimates, came a bevy of biological samples which continue to provide valuable fishery-dependent data for stock assessments.

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

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

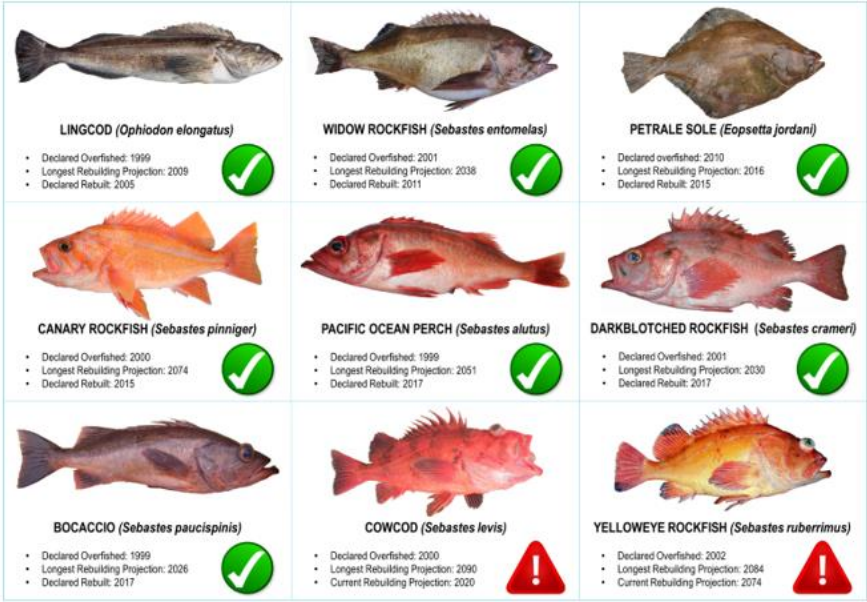

Figure 1: West Coast groundfish species declared overfished since 1999. Pacific whiting excluded, due to the brevity of its overfished status (2002-2004) and relatively low impact on non-whiting groundfish fisheries.

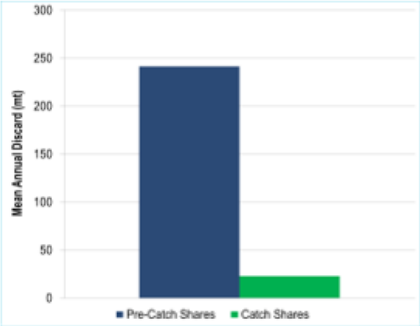

Figure 2: Mean annual discards for the 8 overfished rockfish species and petrale sole. Pre-Catch Shares = 2004-2010; Catch Shares = 2011-2016.

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

Thanks!

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

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

A.Relot

Oceanic Développement, France

Introduction

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

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

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

Definitions

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

General organization of the Program

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

Since the beginning of OCUP, actions have consisted in:

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

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

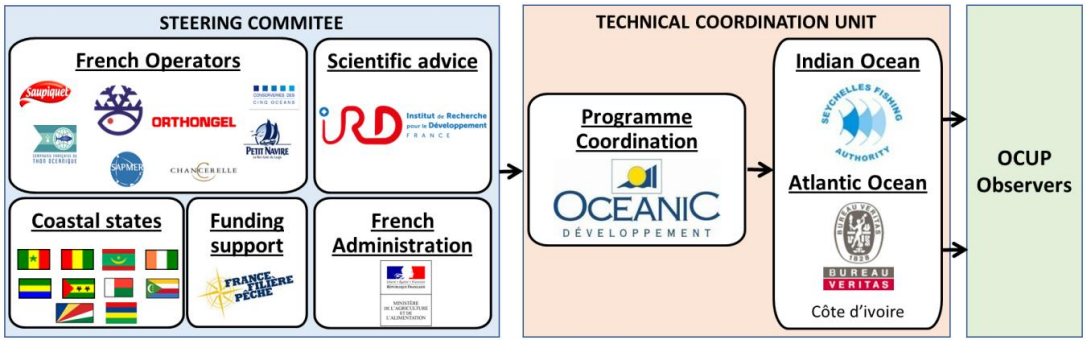
Elaborating and providing a specific training for national observers from (and designated by) coastal countries willing to participate;

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

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

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

OCUP Program organization chart:



Training of observers

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

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

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

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

<u>OCUP observer tasks</u>

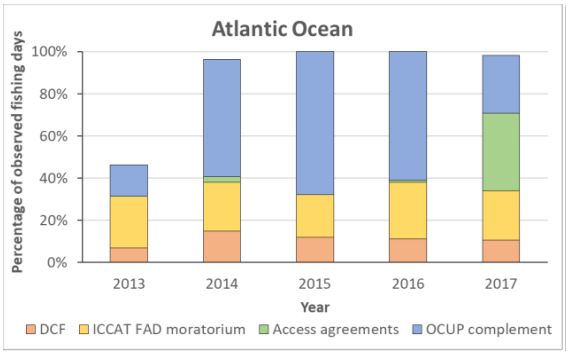
OCUP observers are primarily in charge of collecting mandatory scientific data and information on the application of ORTHONGEL best practices. Control is not part of the mission of OCUP observers, however all collected data is made available to coastal States with an objective of full transparency.

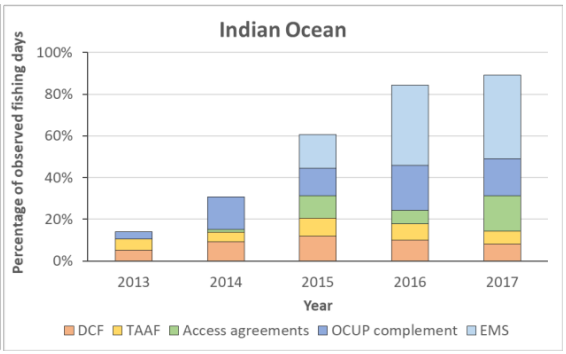
Report and data sharing

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

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

Results of the OCUP program:





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

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

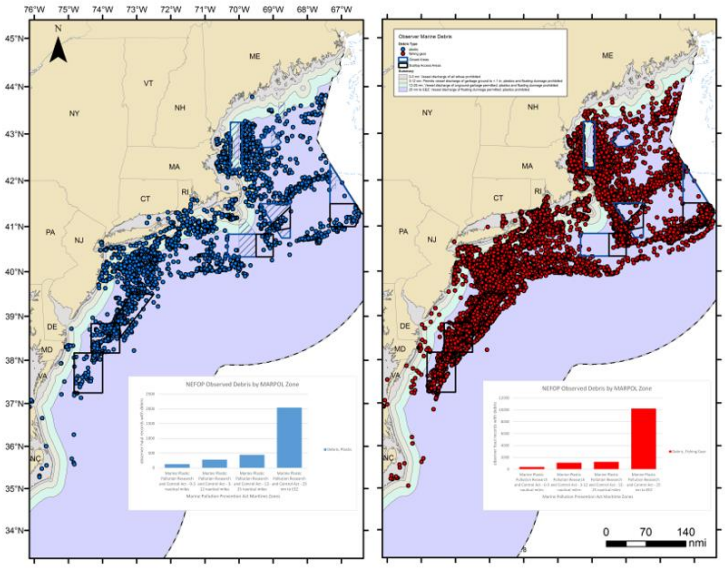
Observing the impact of plastics in the Atlantic Ocean

Zachary Fyke

AIS Observer

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

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



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

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

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

Antônio Olinto Ávila-da-Silva[1], Marcus Henrique Carneiro[1], Jocemar Tomasino Mendonça[1], Gastão César Cyrino Bastos[1], Laura Villwock de Miranda[1], Rafael Cabrera Namora[2]

[1] Instituto de Pesca. Av. Bartolomeu de Gusmão, Brazil,

[2] Fundação de Desenvolvimento da Pesquisa do Agronegócio, Fundepag.

Background

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

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

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

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

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

Marine Fishing Monitoring in São Paulo State

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

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

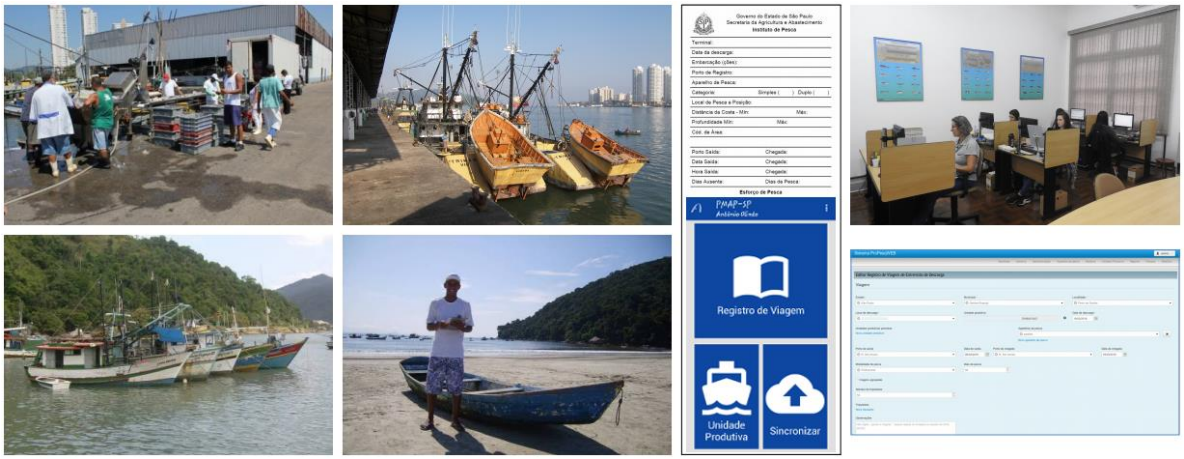


Fig. 1 – Monitoring, processing and storing information from marine artisanal and industrial marine and estuarine fishing fleets in São Paulo State, Brazil.

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

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

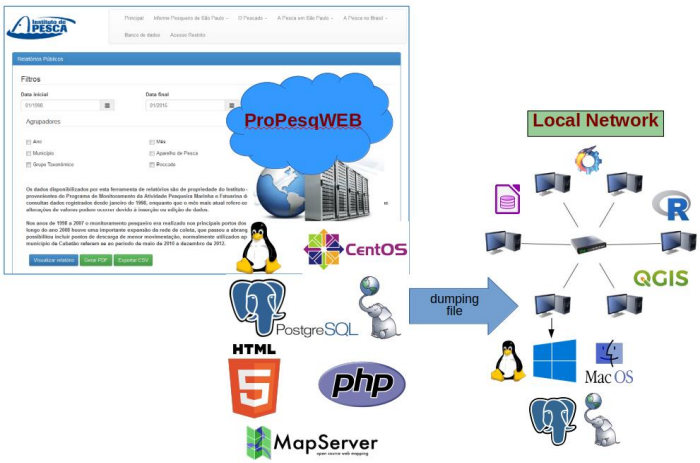


Fig. 2 – ProPesqWEB fisheries database website, environment, workflow and integration capabilities. www.propesq.pesca.sp.gov.br

Conclusions

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

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

Juan Pablo Seco Pon[1], Gabriel Blanco[2], Leandro Tamini[3] and Marco Favero[1]

[1] Institute of Marine and Coastal Research (IIMyC), National University of Mar del Plata - CONICET, Mar del Plata. Argentina
[2] National Institute for Fisheries Research and Development (INIDEP), Mar del Plata. Argentina
[3] AVES ARGENTINAS- AOP, Mar del Plata. Argentina

Introduction

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

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

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

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

Materials and methods

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

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

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

The asymmetry evidenced in terms of the degree of observer coverage and difficulties in determining incidental mortality in different fishing strata (particularly between longliners and trawlers) makes a particular effort in trawler fleets (both ice/fresh and freezer vessels)

essential to quantify the interaction levels and consequently define risk levels through proximal indicators.

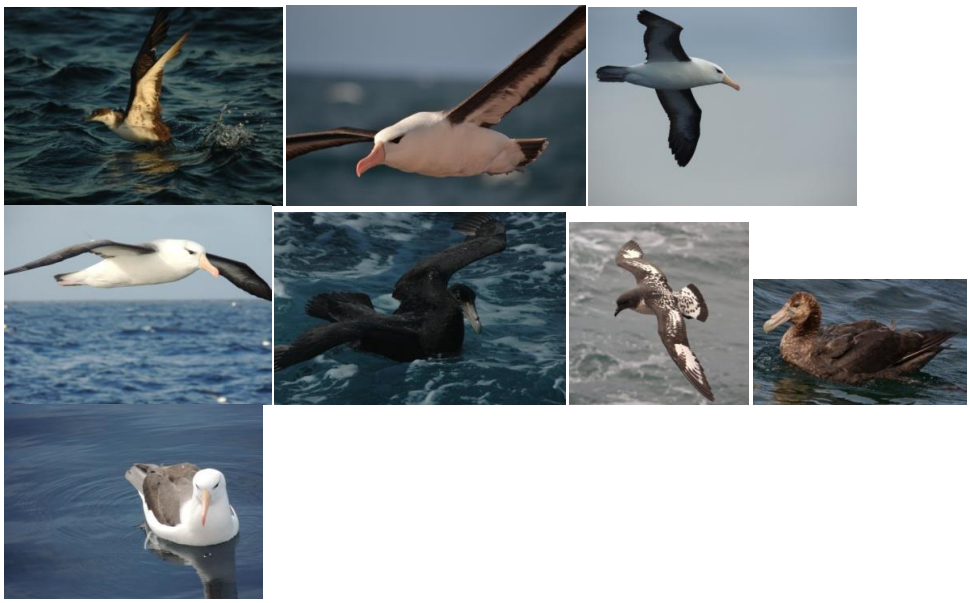
Type vessel per year	Trips	Abundance censuses (1)	Interactions censuses (2)	Observed mortality (3)	Hauls	Collisions / Mortality (4)
2011						
Side trawlers	14	275	224	5	310	3401
Stern trawlers	4	36	21	1	39	157
Freezer trawlers	-	-	-	-	-	-
Surimi processors trawlers	8	70	3	3	74	298
Longliners	15	129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

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

Results

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

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



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

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

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

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

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

The low mortalities registered during 2010 can be associated with the implementation of the Resolution of the Federal Fisheries Council N ° 08/2008 (regulated in 2010), the reduction in the number of operational vessels, the cessation of activities of the longline stratum that operated on the resource " rays ", the use of gear (" cachaloteras ") with higher

sinking rates in at least two vessels, or a combination thereof. To date, there is no robust information to define the levels of implementation of conservation measure Federal Fisheries Council No. 08/2008, although this is expected to be reported in future reports. It is also important to note that the use of the referred "sperm whales" should be monitored when suspected that they can cause problems associated with the ingestion of hooks by discarding fish heads containing hooks difficult to extract.

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

Philip Lens

Pacific Islands Forum Fisheries Agency

Introduction

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

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

Rationale

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

Debriefing provides a mechanism to:

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

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

PIRFO briefing

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

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

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

A formal Notice of Intention to place an Observer is prepared by the Observer Coordinator and send to the vessel operator advising them of the intention to place an observer on the vessel. Travel arrangement are made through the travel agent for observers when boarding

vessels away from their home port, while home port placements is facilitated by a local placement officer who takes the observer to the harbor or dock for placement formalities.

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

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

PIRFO debriefing

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

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

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

Dealing with critical incidents

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

ascertain the outcome of the case for record keeping purposes, and inform the observer concern on the case.

Conclusion

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

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

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

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

Jennifer Mondragon, Jennifer Watson and Alicia Miller

NOAA Fisheries, Alaska Regional Office, Juneau, Alaska, US

Introduction

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

Catch Monitoring Approaches

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

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

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

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

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

Conclusions

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

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

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

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

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

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

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Monitoring the compliance with Landing Obligation

C. Morgado, M. Santos, M. Nuevo

European Fisheries Control Agency, Vigo, Spain

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

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

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

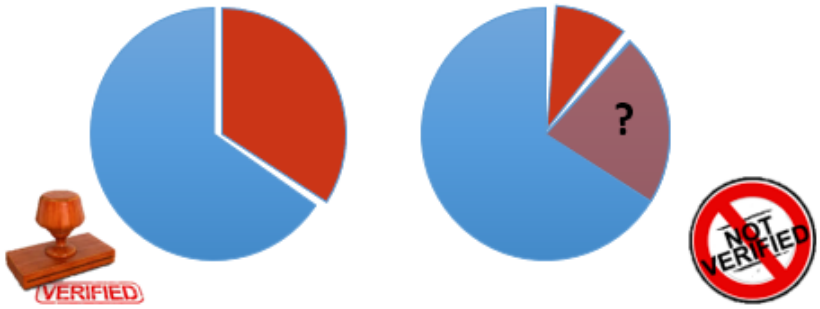

Figure 1. Representation of the methods used to estimate unreported discards on non-verified data based on verified data.

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

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

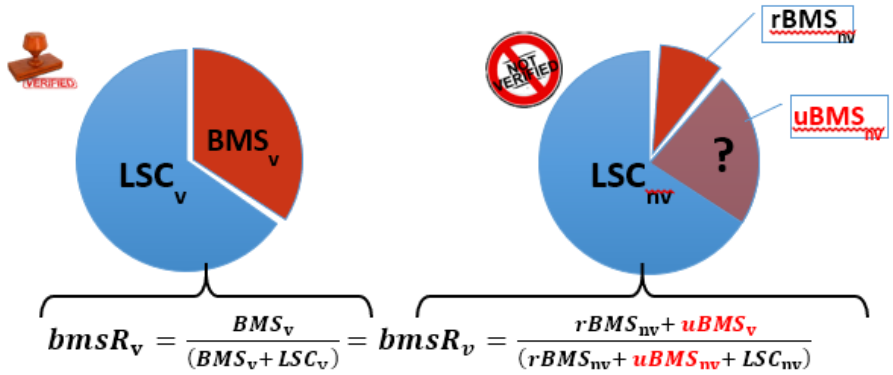

Figure 2. Representation of the method to estimate BMS discards from the LH data. BMS: bellow minimum size; LSC: legal size catch, which corresponds to above minimum size; v: verified data (LH); nv: non-verified data (logbook); bmsR: BMS ratio.

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

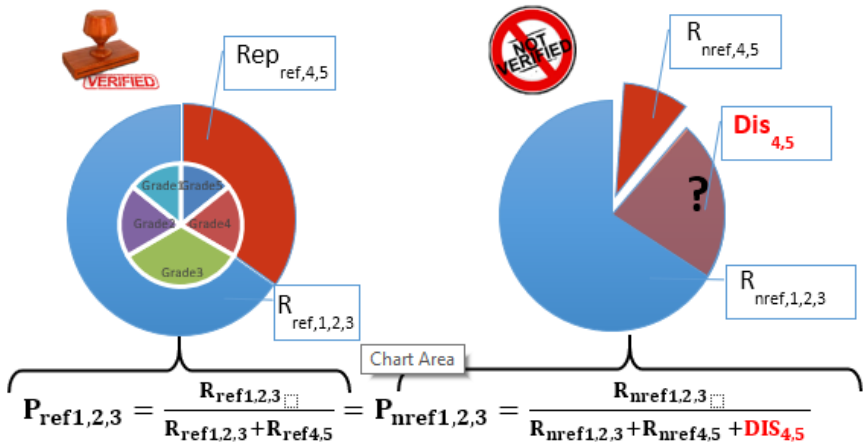

Figure 3. Representation of the method to estimate high grading (discards of legal size catch). $P_{ref1,2,3}$: proportion of grades 1, 2 and 3 of the total catch, from reference data (either vessels with a REM or grade size collected during LH). $P_{nref1,2,3}$: proportion of grades 1, 2 and 3 declared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

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

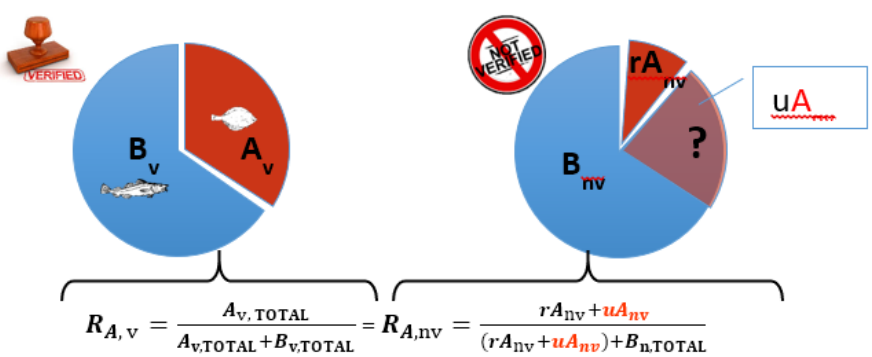

Figure 4. Representation of the method to estimate discard when there is no reference data with size composition. A: quantities of *Species A*; B: quantities of *Species B*: v: verified data (LH); nv: non-verified data (logbook). rA: reported catches of *Species A*; uA: un-reported catches of *Species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

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

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

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

Marlon Roman, Cleridy Lennert-Cody and Enrique Ureña

Inter-American Tropical Tuna Commission, La Jolla, CA, USA

Introduction

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

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

Survey of vessel characteristics and fishing operations

The purpose of the survey was: 1) Identify operational characteristics that may affect placement of EM equipment and data collection. 2) Provide data to help with selection of

participating vessels. 3) Generate data to assist in development of a pilot EM sampling design. Several questions were consulted around four topics: Catch handling, operational characteristics of the vessel, FAD deployment, and vessel characteristics.

Survey results

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

Implications for camera placement

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

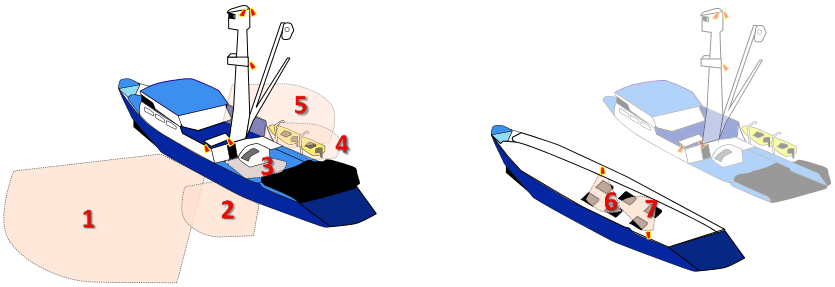

Figure 1. Implications for camera placement on board the tuna purse-seine vessel.

Identifying group of vessels for vessel selection

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

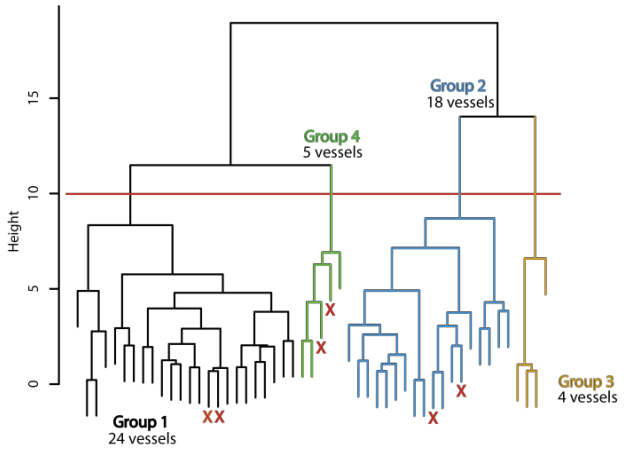

Figure 2. Hierarchical cluster analysis for selecting vessels for EM data collection.

Criteria for selecting vessels for EM data collection

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

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

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

Agus Setiyawan[1,2], Agustinus Anung Widodo[2], Fayakun Satria[3] Chandra Nainggolan[4], Simon Petrus Mandak[4]

[1]College of The Environment Life Science, University of Rhode Island, USA
[2]Center Research for Fisheries, Ministry for Marine and Fisheries Affairs, Indonesia
[3]Research Institute Marine and Fisheries, Ministry for Marine and Fisheries Affairs, Indonesia
[4]Fishing Technology Department, Fisheries University of Jakarta, Indonesia

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

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

Introduction

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

Methods

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

Table 1. Data Summary

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

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

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

$$Ln = \left[\frac{1}{Sl} \quad 1\right] = S1 - S2^{*}\,L$$

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

Where: SL = Standard Length

S1 = *Intercept* (a)

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

Results

Total Catch

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

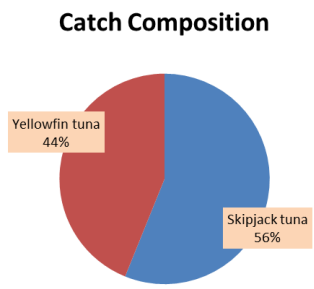

Figure 1. Catch Composition

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

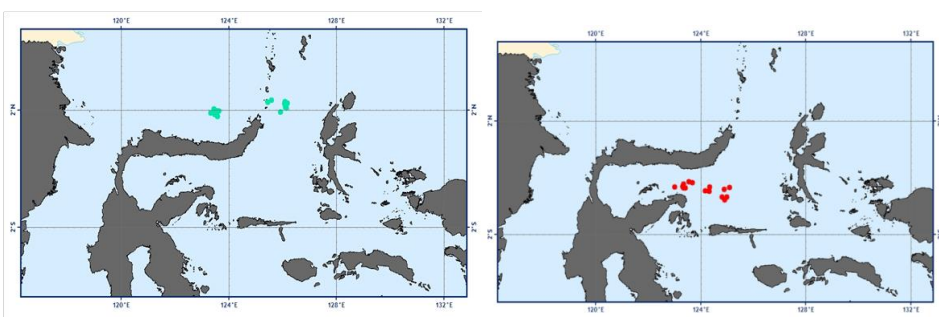

Figure 2. Fishing Ground

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

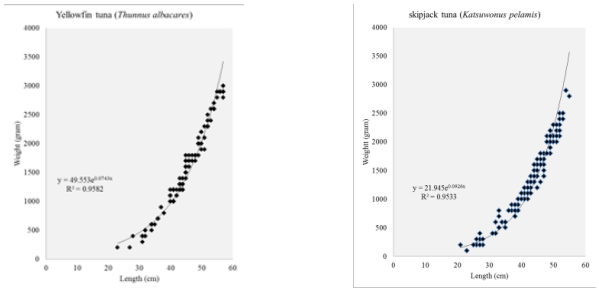

Figure 3. The Relationship between length and weight

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

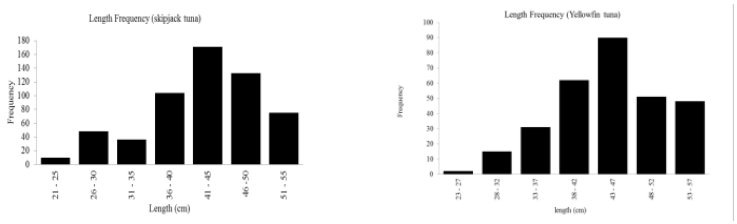

Figure 4. Graph of Length Distribution

Length at First Capture (*Lc*)

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

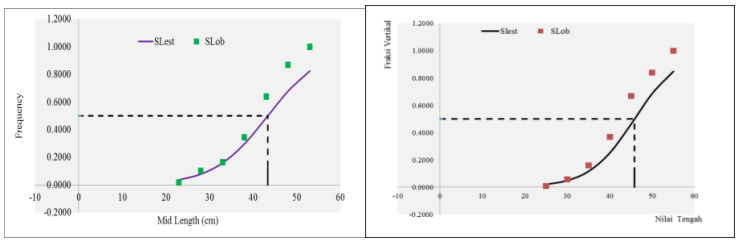

Figure 5. Length at First Capture SKJ and YFT

Conclusion

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

Acknowledgment

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Fisheries Data Collection - The Norwegian way

Tom Williams[1], Jens Altern Wathne[2]

[1]Institute of Marine Research, Norway
[2] Norwegian Directorate of Fisheries

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

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

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

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

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

Coastal Fisheries App

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

Electronic Catch Logbook (ERS)

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

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

The Reference Fleet

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

Port Sampling of Landed Catches

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

Inspections by the Coastguard and fishing authorities

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

Structured Catch Sampling in the Pelagic Sector

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

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

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Sampling on board the Portuguese purse seine fleet

Diana Feijó, Laura Wise, Ana Cláudia Fernandes, Tiago Bento, Jorge Barra, Mário Correia, Daniel Pinto, Rúben Lechuga, Mónica Felício, David Dinis, Mónica Inácio, Diana Pereira, Paula Abreu, Neide Lagarto, Catarina Maia, Pedro Gomes, Ana Luísa Ferreira, Dina Silva, António Fernandes, Carlos Barbosa, Pedro Lino, José Luís Sofia, Tibério Simões, Ana Moreno, Alexandra Silva, Manuela Azevedo

IPMA, Instituto Português do Mar e da Atmosfera, Portugal

Introduction

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

Methods

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

Results

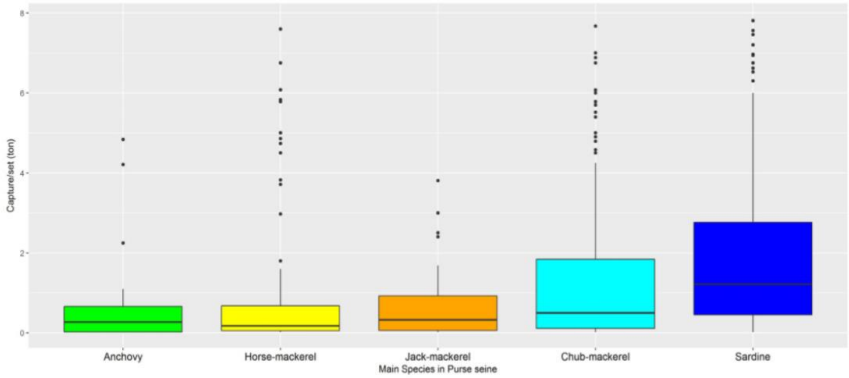
Since 2005, 22 observers monitored 69 fishing vessels (≈ 50% of the purse-seine fleet and less than 0.5% of landing trips per year) operating in 15 ports along the Portuguese coast (Table 1).

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

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

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

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



Conclusions

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

Acknowledgements

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

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

Jocemar Tomasino Mendonça[1]; Mayra Jankowsky[2], Antônio Olinto Ávila-da-Siva[1]

[1] Instituto de Pesca, APTA/SAA/SP,
[2] Fundação de Desenvolvimento da Pesquisa do Agronegócio, SP

Introduction

Currently, brazilian fishing involves more than one million fishermen, generating more than 800 tons of fish per year (MPA, 2011). Fishing monitoring aims to generate statistical information to subsidize studies of the activity performance, evaluating stocks in operation,

identifying potential alternative fishing grounds and conducting various sectoral analyzes aimed at the sustainable management of resources (Aragão, 2006). Monitoring guides decision-making and help in implementation of rules to maintain the minimum resource levels for survival of fishing (Policansky, 2001). The present work presents experiences of monitoring use subsiziding fisheries management in two marine protect areas in São Paulo e Paraná States, Brazil.

Methodology

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

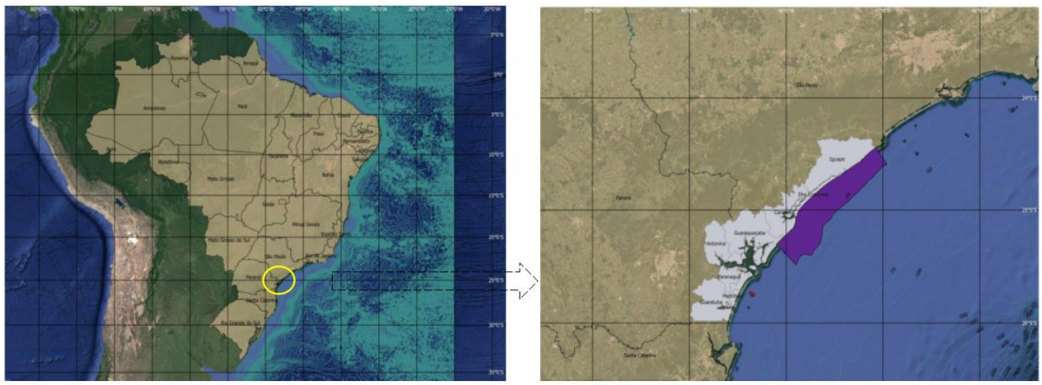

Figure 1. Map with research area (yellow circle). Red: PARNA Currais e Purple: APAMLS.

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

Results and Discussion

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

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

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

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

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

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Abstracts of presentations that did not provide Extended Abstracts

Underlying reasons and requirements for monitoring fisheries

Sam Rauch

United States NOAA Fisheries

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

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

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

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

Sekiwe Mbande and Victor Ngcongo

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

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

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

Derrick Tagosia

The Ministry of Fisheries and Marine Resources, Solomon Is

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

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

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

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

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

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

Steve Samana

Alaskan Observer Inc.

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

levis) and yelloweye rockfish (Sebastes ruberrimus) and how; once again, Fort Bragg is a key focal port to examine the progress.

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

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

DTU Aqua - National Institute of Aquatic Resources, Denmark

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

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

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

Vanessa J. Tuttle, Jason Jannot, Tom Good

NOAA Fisheries

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

Fostering Growth Between Science and Compliance

Matthew Walia

NOAA Fisheries, USA

Fishery monitoring decisions are based on the specific country, fishery and data goals. The United States has pursued a nation-wide approach to marine fisheries conservation by enacting the Magnuson-Stevens Fishery Conservation and Management Act in 1976. The Magnuson-Stevens Fishery Conservation and Management Act has complex goals aimed to prevent overfishing, rebuild overfished stocks, increase long-term economic and social benefits, and ensure a safe and sustainable seafood supply. Based on the 2016 annual Status of Stocks report released by National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries), 92% of all managed stocks/stock complexes were within their annual catch limits (474 total stocks/stock complexes). Economic, biological and environmental information taken for management purposes by observers play a critical role in stock determinations. Specifically, in the United States Southeast Region, observers collect data through three observer programs based out of Texas and two cities in Florida. A large variety of species are monitored from shrimp to reef fish to highly migratory species; targeted by multiple gear types. NOAA Fisheries Office of Law Enforcement (OLE) has worked with the observer programs closely since 2013 when reporting procedures were enhanced, and these recently updated reporting measures have improved the cooperation and communication between the two divisions; leading to more accurate management decisions, as well as observer safety. Observers collect data needed for management

decisions and in turn, need to be confidant that they can do so effectively and safely. NOAA OLE considers observer program concerns a high priority and the reporting measures enacted in the three Southeast programs will be discussed, as well as examples of observer collected data leading to better compliance and safety measures. Compliance issues are broken into five categories with varying degrees of severity under each category; gear violations, handling prohibitions, retention limits, spatial violations and observer compliance/harassment. A successful rapport of law enforcement and the observer community is essential in obtaining stewardship and conservation goals.

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

Jakub Skorupski and Aneta Kozłowska

Green Federation "GAIA", University of Szczecin

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

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

Kevin Stockmann

Alaskan Observers Inc. Observer, USA

One of NOAA Fisheries’ guiding principles is to conserve and manage fishery resources to realize their full economic potential while also preventing overfishing and ensuring rebuilding of overfished stocks.Yellowtail rockfish and Chilipepper rockfish are abundant,

currently underused, species ranging the Pacific Coast of North America. These species, and several similar rockfishes, were historically harvested with vertical hook and line gear (also known as mid-water jig gear) featuring artificial lures known as shrimp flies.

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

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

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

Session 2. Industry engagement with monitoring

Leader: Lisa Borges

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

Oral Presentations - Extended Abstracts

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

Elena Balestri

Scottish Fishermen's Federation, UK

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

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

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

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

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

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

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

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

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

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

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

Alex Perry

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

Background and Problem Statement

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

Methods

In 2016 and 2017, the National Marine Fisheries Service (NMFS), in collaboration with industry stakeholders (vessel owners, captains, and Alaska Groundfish Data Bank), initiated efforts to improve catch estimation via observer sampling in the Central GOA rockfish fleet by: 1) attempting to increase observer sample size and number of samples, and 2) improving observers' ability to optimize random sampling techniques available to them. Achieving stakeholder buy-in was essential to successfully implementing these efforts. Educating the fleet that the North Pacific Observer Program's efforts sought to improve all catch accounting, including Chinook salmon mortality estimation, achieved that buy-in from the fleet. The fleet was encouraged to assist observers in collecting their samples by improving observer access to fish and sample storage space. Outreach and education was conducted both with the fleet and with observers. Methods included: 1) presentations to the Kodiak Rockfish catcher vessel trawl fleet at biannual trawl fleet meetings; 2) an educational packet written by Kodiak Observer Program staff comprising: an Agency

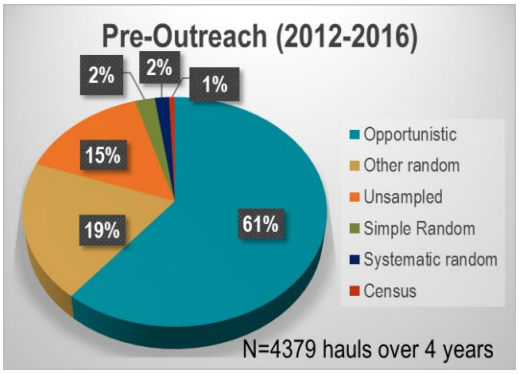
outreach letter explaining the Observer Program's outreach efforts, an informational page to instruct observers about the outreach, a sample design flow chart specific to this fleet to assist observers in designing random samples, and a post-trip questionnaire; 3) observer training of new sample design methods starting in 2016 (where sample units are evenly divisible into observer catch estimates); 4) in office instruction to observers and post-trip interviews (to discuss how sampling went); and 5) conducting on-vessel pre-cruise meetings with the vessel owners/captains/crew, Observer Program Kodiak field staff, and observers.

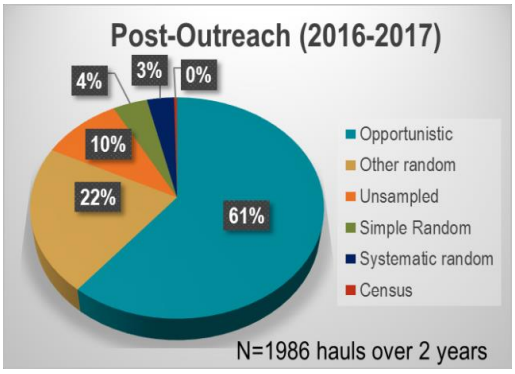
This presentation looks at observer sample data from 2012-2015, and compares them to observer data in 2016 and 2017, using the following metrics: 1) sample size, 2) sample design and randomization, and 3) number of samples, all on a per-haul basis. These three metrics were selected as the best indicators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

Results and Discussion

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

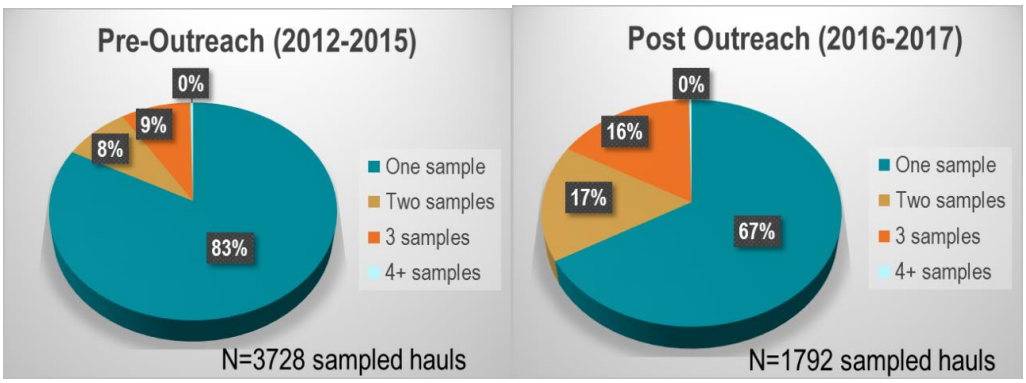
Sample Design and Randomization: sample designs are 1) opportunistic (meaning no attempt was made to randomize the collection of the sample); 2) other random (contains an element of randomization to the collection, but the entire population is not available to the observer); 3) simple random; 4) systematic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





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

Number of Samples per Haul:



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

Conclusions and Future Directions

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

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

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

Using scientific observer data to validate pelagic self-sampling data

Pastoors, M.A.[1], van Overzee, H.M.J.[2], van Helmond, A.T.M.[2], Verver, S.W.[2], Wójcik, I.[3]

[1] Pelagic Freezer-trawler Association, The Netherlands.
[2] Wageningen Marine Research, IJmuiden, The Netherlands
[3] National Marine Fisheries Research Institute, Gdynia, Poland

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

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

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

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

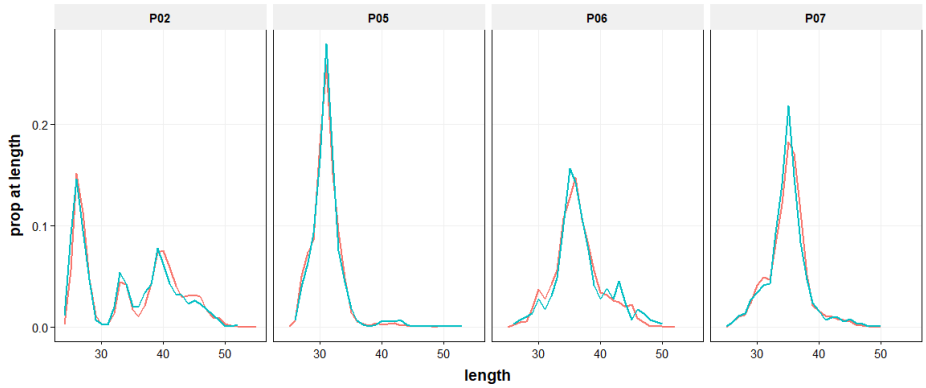


Figure 1 Proportion at length of Jack Mackerel (Trachurus murphyi) estimated from self-sampling (green line) and by scientific observers (red line). Each panel denotes a trip.

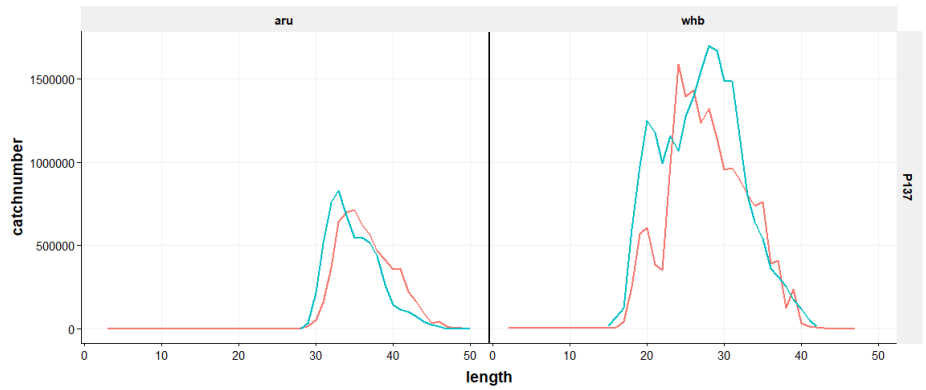


Figure 2 Raised length compositions of Greater Silver smalt (Argentina silus, ARU) and Blue whiting (Micromesistius poutassou, WHB) estimated from self-sampling (green line) and by scientific observers (red line) during trip P137.

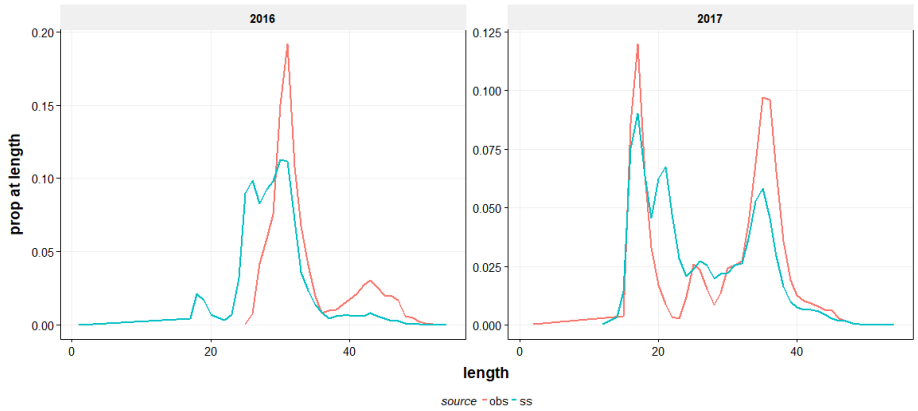


Figure 3 Proportions at length by year for Jack mackerel (Trachurus murphyi, CJM) estimated from self-sampling (green line) and by scientific observers (red line). The differences in proportions at length are caused by a difference in coverage of fishing grounds and seasons.

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

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

[1]Natural Resources Consultants,
[2]Ecotrust Canada

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

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

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

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

approach to collecting lost traps; to better document the potential negative impacts of lost traps to harvest revenue; and to return lost traps to harvesters.

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

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

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

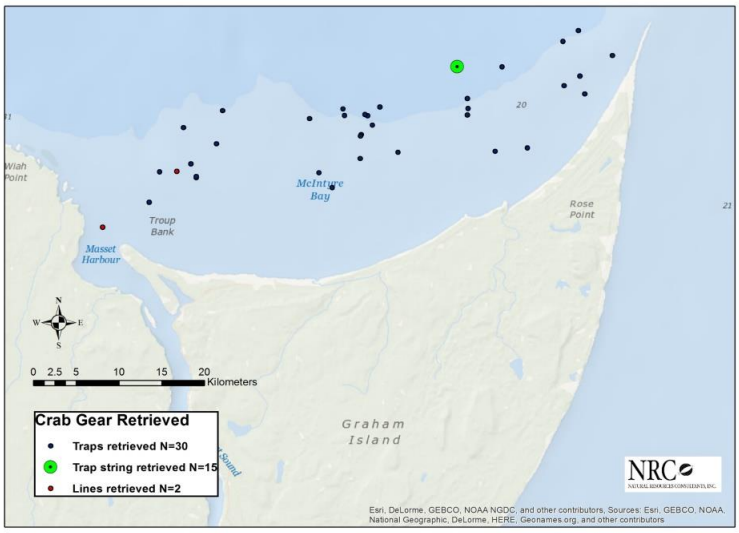


Figure 1. Locations of retrieved crabbing gear, McIntyre Bay, June 4, 2017

Open Discussion Session

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Poster Presentations – Extended Abstracts

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

Tom Williams, Sofie Gundersen and Tom Clegg

Institute of Marine Research, Norway

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

The most motivational factors for the fishermen's participation in the RF were listed as "*Social responsibility and a wish to strengthen fisheries management"* as well as "*The opportunity to contribute to marine research"* by fishermen in both the coastal RF and high-

seas RF. "*Payment"* was seen as a more important factor by the fishermen in the coastal RF, than in the high-seas RF, but both regarded it as the second or least important motivational factor.

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

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

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

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

Margaret Heinichen, Katherine McArdle, Michael Palmer

NOAA Fisheries, USA

As monitoring programs become more technologically advanced there is an increasing need for communication and outreach with primary stakeholders. Industry adoption of new data collection programs and systems can be challenging as some industry members may be more comfortable with current systems. The outcome of a successful outreach initiative would be to reach as many stakeholders possible with them absorbing the maximum

amount of information during the outreach event. Other measures of success would be approval by the industry, compliance of new protocols, and for the industry to feel like their inputs were valued.

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

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

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

During the outreach event the outreach team started with a presentation describing the technical and potential policy changes and then went into a demonstration of the actual system using a test site. Outreach was also done through user manuals, formal discussions at established outreach events, and informal discussions with industry members via phone or email. The presentation was generally useful, though some attendees lost interest as there was a heavy focus on regulatory history as to why the PTNS was required. The fishermen in attendance found the demonstration helpful to be able to walk through certain

situations. User manuals have the potential to be a good reference for users with only a few questions. Formal outreach events had much better success when the audience was exclusively groundfish fishermen rather than including those who participate in other non-groundfish fisheries. Informal discussions only occurred when an industry member reached out to the PTNS team, but it was extremely beneficial in being able to focus on specific topics that the stakeholder cared about.

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

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

[4]

Involving Industry in the Collection of Needed West Coast Groundfish Data

Jim Benante[1], John Lafargue[2]

[1.] Pacific States Marine Fisheries Commission, USA

[2.] NOAA Fisheries, USA

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

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

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

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

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

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

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

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

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

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

sportfishing vessels are truly transformed into scientific survey vessels utilizing state of the art technical equipment and operated by captains and crew with a vast amount of local knowledge and experience.

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

Bryan Bates

Archipelago Asia Pacific, Australia.

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

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

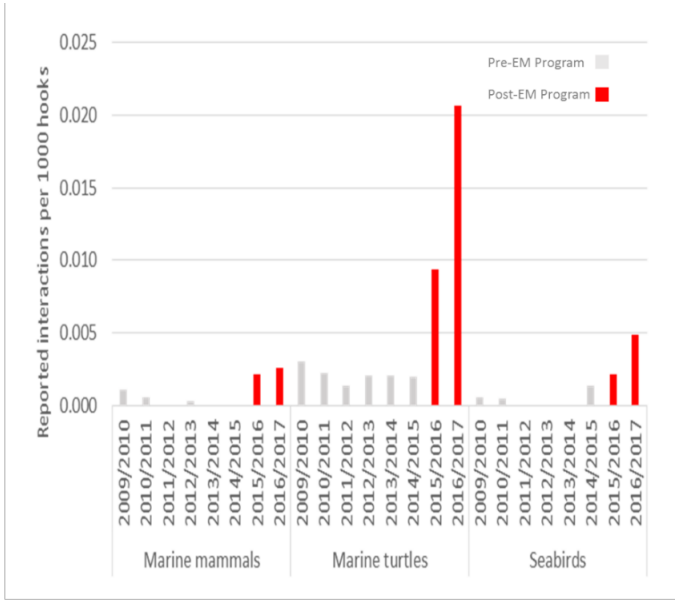


Figure 1: CPUE of reported TEP species interactions in the ETBF

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

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

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

Isaac Forster, Keith Reid

CCAMLR Secretariat

Introduction

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

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

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

Methods

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

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

Results

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

Conclusion

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

Figure 1.

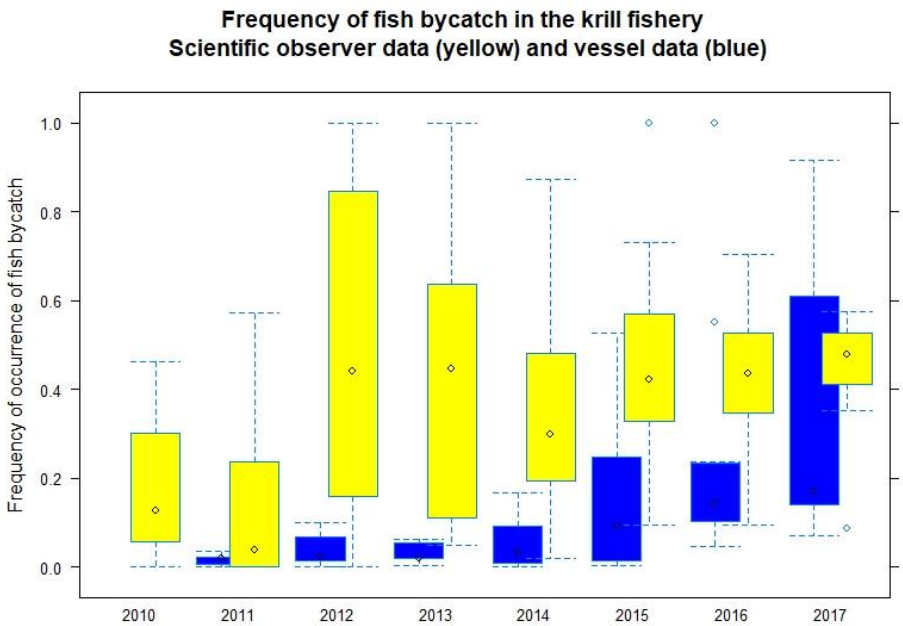
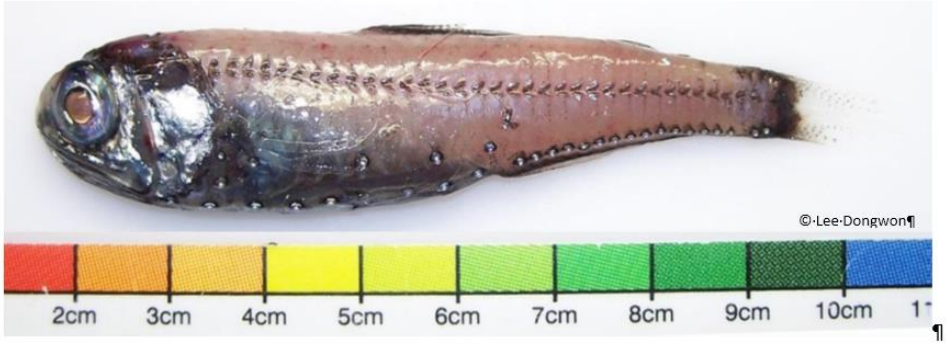


Figure 2. Example CCAMLR Bycatch Guide ID Plate

Figure·2.·Example·CCAMLR·Bycatch·Guide·ID·Plate¶

Electrona·carlsbergi·(Lanternfish)·(ELC)¶



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

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

Size: To 9 cm TL.

Distribution: Widespread in the Antarctic

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Depth: 100 to 350

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

Julien Hawkins

Vericatch, Canada

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

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

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

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

Objectives

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

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

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

Methodology

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

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

In addition to FisheriesApp, Vericatch has been piloting KnowYour.Fish, the industry's first truly verifiable and traceable seafood supply chain platform, with the same fishery and associated brand-name processors in North America. Based on the positive results from the

pilot, KnowYour.Fish has now launched to a broader customer base as a means of showing the commercial benefit to fisheries.

Results

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

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

Conclusions

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

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

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

Madirolas Adrián, Hansen Jorge, Orlando Paula y Blanco Gabriel

National Institute of Fisheries Research and Development, Argentina

Introduction

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

Main objective

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

Materials and methods

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

$$TS = 15.8 \log10 (LT) - 66.0 \text{ dB}$$

Results

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

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

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

Conclusions

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

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

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

[1]Northeast Fisheries Science Center, Woods Hole, MA;

[2]Massachusetts Division of Marine Fisheries, Gloucester, MA;

[3]Cape Seafoods, Inc. Gloucester, MA

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

documenting the need for, and application of, increased communication between fishermen, monitoring programs and managers to support successful fisheries management.

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

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

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

Abstracts of presentations that did not provide Extended Abstracts

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

Kevin Stockmann

NOAA Fisheries West Coast Groundfish Observer, San Francisco, USA

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

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

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

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

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

Industry Involvement with Monitoring Sex in the Pacific halibut Commercial Fishery

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

International Pacific Halibut Commission

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

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

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

Sarah Fortuna

NEFOP Observer

One of the most difficult things about being an observer is getting on the boats. There are many reasons fishermen don't want to take observers; the most prevalent is an aversion to the "big brother" effect. These people, many of them whom have grown up in coastal communities in families that have always had ties to the ocean, are not particularly fond of "big brother" being invited into the picture. Suffice it to say the federal government has always been involved in the harvesting of natural resources (ie. the ocean and its fishes) but before the observer program putting observers on boats it was in a less direct manner. Yes, the government controlled the quotas and landings but what went on out on the ocean was

largely private. Many of the fishermen I have spoken with have few problems with observers it is largely the fact that the data that are collected “always has a way of being turned into a negative”. “They never get anything out of it.” Limits are lowered, areas are closed and once again the fishermen are left feeling used.

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

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

Tom Williams

Institute of Marine Research/Directorate of Fisheries - Norway

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

important spatio-temporal trends in the seabird bycatch, allowing for effective mitigation measures such as ambulant protection zones and fishing periods.

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

Michael Marsik

US- NOAA Fisheries

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

Session 3. Monitoring artisanal fisheries

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

Oral Presentations - Extended Abstracts

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

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

CEFAS, UK

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

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

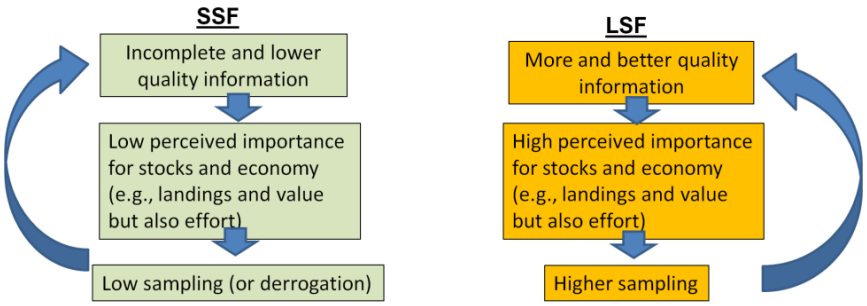
- ✓ National description of SSF, contribution to the total catches and fishing effort
- ✓ Overview of the current SSF data collection methods, pros and cons
- ✓ Best practice guidelines for fishing activity and biological data collection in SSF

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

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

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

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



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

Based on questionnaires, presentations, working documents and discussions within WGCATCH, building on previous works, the group documented the importance of SSF and

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

Overview of the current SSF data collection methods, pros and cons WGCATCH documented the sampling practices for SSF in ICES areas mainly.

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

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

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

Best practice guidelines for fishing activity and biological data collection in SSF

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

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

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

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

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

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

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

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

Alexandra Guerreiro[a], Luis Rodrigues[a] and Miguel Machete[b]

[a] Regional Secretariat of Sea, Science and Technology, Regional Directorate for Fisheries, Horta (Azores, Portugal).
[b] Institute of Marine Research – IMAR - University of the Azores, Horta (Azores, Portugal).

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

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

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

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

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

In 2000, an EU framework for the collection and management of fisheries data was implemented under the Common Fisheries Policy. Under this framework the region collect and manage biological, socio-economic and environmental data of local fisheries. Information on catches was achieved through a specific observer program that deployed observers on long line and hand line vessels in all Azores area. The Regional government is also partner and co-founder of several scientific projects that are focused on data collection and surveys. Concerning the highly pelagic migratory species the scientific project Consolidating Sea Turtles Conservation in the Azores (COSTA) managed by IMAR (Institute of

marine research) has ensured the collection of catch data and effort from the surface longline fishery since 2015 including the delicate subject of marine turtles by-catch. A monitoring, control and surveillance (MCS) system is implemented in the Region that is currently expanding the already established, since 2010 the Vessel Monitoring Systems (VMS) to all fleet segments to track and monitor all professional fishing activities in Azores area. Additionally, during the last couple of years, the Region has also installed surveillance cameras in some harbors to control and dissuade illegal practices.

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

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

Jérôme Weiss, Séverine Boucheron, Sébastien Demanèche, Patrick Berthou

IFREMER, France

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Wahyu Teguh Prawira

Yayasan Masyarakat dan Perikanan Indonesia

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

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

The Vessel Characteristic

The hand line vessels in this project is made from (combine) wood and fiber using portable 5 – 15 HP engine. They are usually plugged off the engine after fishing and plugged in before

fishing. All of fishermen in these four regions are going fishing in the morning and back home in the evening.

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

Figure 1. The Vessel Size

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

<u>Time Lapse Camera and Spot Trace Deployment</u>

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

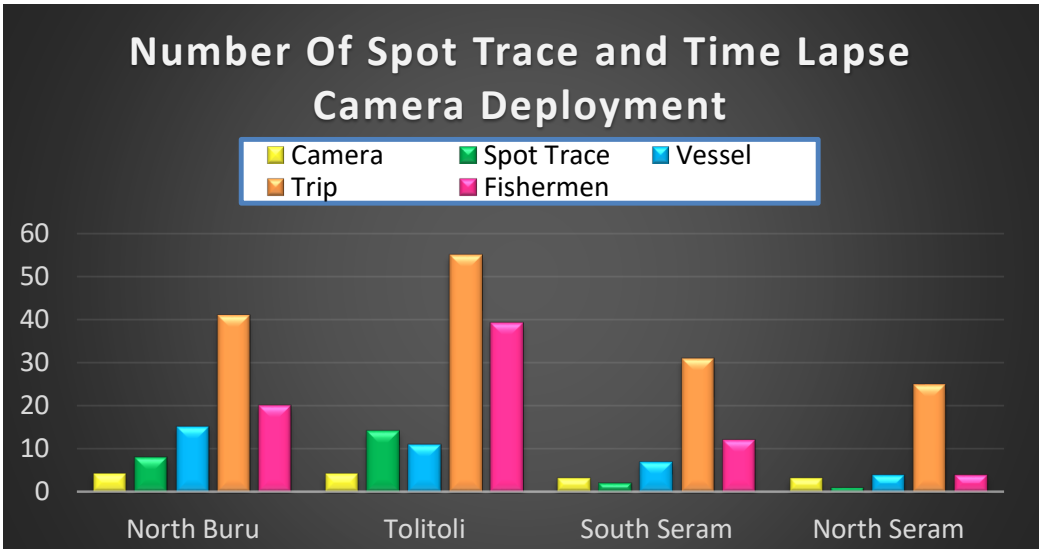

Figure 2. Number of ST and TLC Deployment

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

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

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

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

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

Challenges

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

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

Figure 3. Challenges of ST and TLC deployment

Refers to the challenges table above, technically there is no devices that applicable for this fisheries. For now, Indonesian stake holders are advised to use these low cost electronic monitoring in their supply chain to attain the traceability and transparency information on

their fishery products. Also next steps, that we are working with partners to look at the interoperability of these devices, what adjustments are required, whether we can work to develop an Indonesian-based option, what is needed for such systems to be scaled up beyond a the few vessels we work with, whether the information is necessary for certifications and market (for example, currently MSC does not require onboard observer information for these vessels because neither national nor international law stipulates the observer requirement).

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

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

Carlos Montero-Castaño

Marine Stewardship Council

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

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

The Marine Stewardship Council (MSC) is the most recognized global fisheries certification program worldwide, coherent with the FAO Code of Conduct for Responsible Fisheries and the FAO Guidelines for the Ecolabelling of Fish and Fishery Products from Marine Capture Fisheries. The MSC certification program is based on its standard for sustainable fisheries which provides a global framework of fisheries management best practices. The MSC third-party assessment process therefore allows to recognize those best practices actions and to identify and analyse challenges within specific fisheries management system, including

those related to monitoring, compliance and enforcement requirements. This paper presents the monitoring actions considered at best practice level in MSC certified small-scale fisheries and analyse the activities developed by fishing operators and managers to improve the performance of particular MCS systems in order to achieve sustainability goals.

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

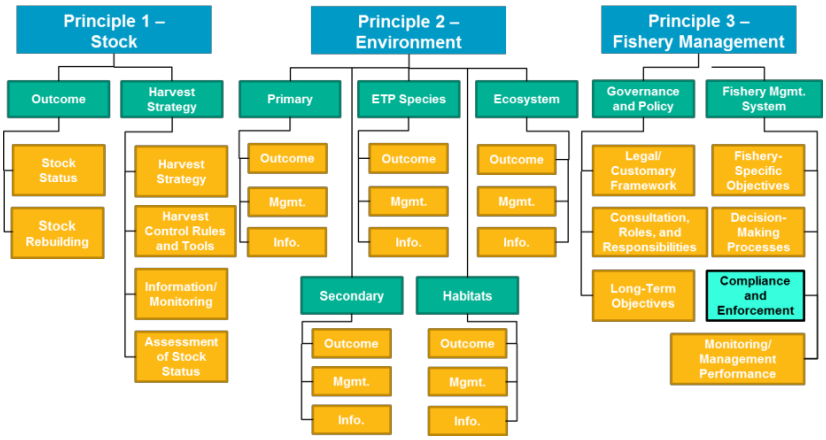

Figure 1: MSC Standard for Sustainable Fisheries (version 2.0)

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

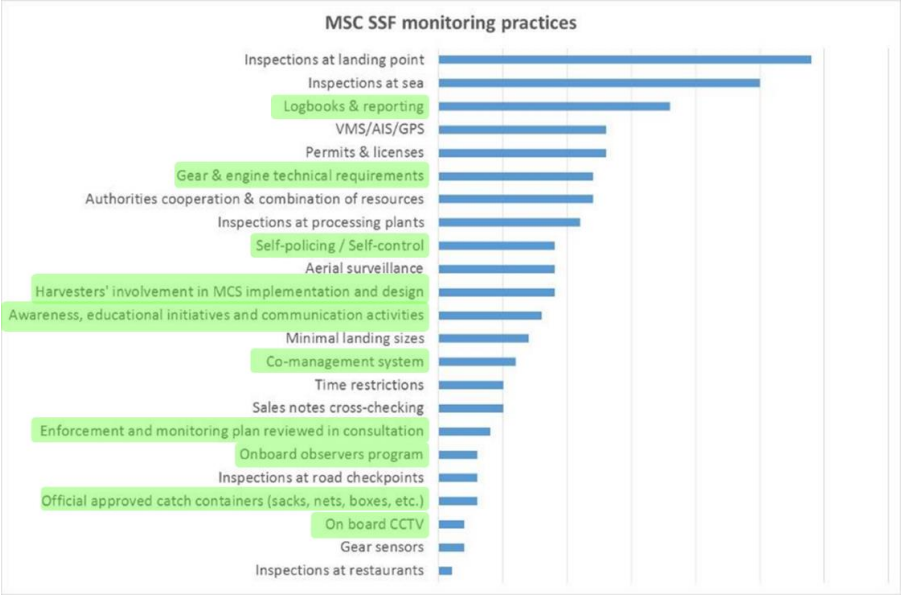

Figure 2: Most commonly implemented monitoring actions in MSC certified small-scale fisheries.

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

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

Open Discussion Session

Q - In these new census to estimate fishing effort you presented, my question for Sebastien is if these fishing vessels are equipped with satellite monitoring control systems?. In Argentina we have developed an algorithm to monitor fishing effort through satellite monitoring
A - For some vessels we have electronic monitoring and we also have a tool to cross check all the data we have: logbooks, monthly fishing forms, sales notes, declarative data, fishing activity calendar surveys, and this is an exhaustive survey. Then we can make some assessments of the completeness of the declarative data that we have, a yes, at the moment we don't have many data from electronic monitoring of the fishing vessels because is just the beginning of the operation. But I think that is good to use this cross validation tool. We use VMS device, all vessels have VMS devices and we use VMS to cross validate the declarative data, logbooks and sales notes.

Q - Very interesting the establishment of small markets to reduce discards and that these discards end up generating income for fishermen. In Argentina, the establishment of markets is complex and very difficult due to strict sanitary and food safety controls, which disincentive these markets, so my question for Steven is how these fishermen managed to improve the performance or how they avoid these controls in order to sell their products to public?
A - I understand that the Health Service comes to the fishing port to perform food safety inspections for people who sell prepared food products. There is a system to evaluate that processing and the products are in accordance with all the necessary sanitary parameters. As for the fish product, it is considered a fresh product and I believe that it is according to the Government's legislation. This helped to facilitate the establishment of the market. Really for San Diego's fishermen the obstacle was processing the fish, they have always been able sell the fish to the public, but it was not allowed to cut and process the fish, so in order to do that kind of processing, the processing of the fish was included in the evaluation of the Health Service.

Q - Question for Carlos Montero from MSC, I found very interesting the way you explained MSC certification and for all the monitoring, including observers and inspections, I can't imagine that MSC has thousands of employees to do that certification, so I imagine that all that work is done through other organizations that already have those employees. The specific question is in 2 parts:
From what I understand, these types of certifications create added value to the fishing products, whatever it is, obviously there are economic incentives for the producer, market incentives. What incentives are there for the people who work in the inspection side, in particular my interest is for the observers. My experience of over 30 years in observer programs has taught me that as long as the value of some fishing product increases and the potential for it to be accepted or not in a specific market, it also increases the pressure on the person who has to do the inspection or monitoring, in particular the observers. then I would like to know how MSC directs or drives those funds where more wealth is created, in particular towards the observers but in general towards the whole monitoring system.
A - Well, for the first question I have to clarify that MSC does not inspect, MSC is not an inspection organization, MSC certifies fisheries and it does it through an independent third party system. This means that there are entities accredited to be MSC certifiers, which with specific evaluation teams collect evidence for each of the fisheries to be assessed. Neither do these evaluation teams embark themselves in the fishing fleets to be inspected. What it is

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

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

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

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

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

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

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

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

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

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

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

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

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

Poster Presentations – Extended Abstracts

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

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

North Pacific Observer Program

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

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

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

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

Along with open communication, taking simple steps such as respecting house rules and cleaning up after yourself goes a long way towards a more peaceful and professional coexistence with vessel crew. Again, this is another topic usually discussed during or shortly after the safety orientation. This holds especially true for the Russian-American longline

fleet mainly based in the central Gulf of Alaska. Many of these vessels follow traditional Russian Orthodox teachings and can be strict about what guests may use in the galley. The stove and oven are the most common appliances unavailable to guests but on other vessels the whole galley can be off limits. Disposable plates and cutlery often help avoid the restriction of using their silverware. Coordinators and other observers will always suggest you bring your own food in case the crew is fasting and meals are simple and infrequent. We do our best to respect these customs, but over the last few years the Russian-American fleet has also had to heavily adjust to our presence and cope with the new requirements of the observer program.

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

Abstracts of presentations that did not provide Extended Abstracts

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

Steven W. Todd

West Coast Groundfish Observer Program, USA

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

in making choices that favor the local, seasonally caught and grown products available at farmer's markets throughout the greater community. San Diego fishermen have also taken

notice of the local demand, and have united to form a seafood only public market merchandising products taken from local waters.

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

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

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

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

Scottish Oceans Institute, University of St. Andrews

Spatial management of the marine environment should underpin sustainable management of the ecosystem including vulnerable and dependent species such as marine mammals, commercial resources such as fish, and human communities that depend on the marine environment for their way of life. Management measures may result in restriction of fishing effort e.g. through closure of areas. To predict impacts of such measures on people and marine species, it is essential to know how fishing is currently distributed and how intense levels of fishing are at local scales. However, the distribution of fishing activity in inshore areas (often carried out by small scale fishing vessels) is currently not well known, though tracking data from AIS and GPS systems are increasingly available. Tracking data can be analysed to indicate the location and speed of boats in time and space, but it is not possible to directly infer where boats are fishing or where they are engaged in other activities (such as travelling to and from their fishing grounds). Patterns of movement associated with particular types of fishing may be detectable e.g. characteristic patterns of speed and turning behaviour when creels are deployed or retrieved. We will present initial results of an

analysis of boat movement data for which there is matching on-board validation of activities during a fishing trip, allowing us to model the association between movement patterns and fishing. We then use a cross- validation procedure to evaluate the model performance by splitting the ground-truthed data into two datasets. The first dataset is used to estimate model parameters and the second, to validate the models by estimating model performance, by assessing the percentage of events in which the predicted behavioural state corresponds to the true behaviour.

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

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

Scottish Oceans Institute, University of St. Andrews, Scotland

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

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

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

Gonzalo Macho, Andrés Simón, Sebastián Villasante and José Molares

Vigo University, Spain

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

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

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

Jordan Taylor

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

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

Traditionally, stock assessments have been analyzed using a single-species approach to management, where biological interactions between targeted species and their predators, competitors, or prey are largely ignored. Since 1990, these assessments and management policies have shifted from the traditional single-species analyses to approaches that attempt to incorporate whole ecosystems into policy decisions, known as ecosystem-based fisheries management (EBFM) (Larkin 1996; Pikitch et al. 2004). Multispecies analyses address ecological interactions, food web/ trophic links, and community compositions, theoretically providing a more comprehensive understanding of overall fishing impacts on a single stock and the ecosystem that supports that stock (Link et al. 2002; Latour et al. 2003; Cury and Christensen 2005). In recent years, more robust analytical techniques have been developed to understand these whole ecosystem interactions. Spatially explicit models have been an invaluable tool for addressing EBFM, because they incorporate ecological interactions with the effects of space. Spatially explicit non-linear modeling has been used to report the distribution of the Arrowtooth flounder, Atheresthes stomias, which is affected solely by water temperature rather than commercial fishing effort (Ciannelli et al. 2012). Similarly, Bacheler and Ballenger (2016) documented changes in the spatial distribution of sizes and catches of Black Sea Bass in the Southeastern US at smaller spatial scales compared to larger ones using variable-coefficient modeling. Another approach, canonical variate analyses (CVA), has been useful in elucidating the forage fish guild structure in six reef fishes of the US South Atlantic Bight through spatial and resource dependence using morphological features (Michael and Smart 2017). These robust and rigorous analyses provide more accurate, non-biased bycatch estimates, as well as abundance and distribution estimates of

target reef fishes over space and time by incorporating ecosystem-based interactions. Recent technological advances, such as long-term video monitoring, have also provided additional means for collecting spatial and temporal data. Vessel monitoring systems (VMS) provide accurate fishing effort estimates and real-time data when observers cannot be present (Lee et al. 2010). These new advances and analytical techniques have revolutionized not only how data can be collected, but also how it can be analyzed, which is an important step towards creating holistic EBFM regimes.