

# PROCEEDINGS OF THE 7th INTERNATIONAL FISHERIES OBSERVER & MONITORING CONFERENCE

**8-12 April 2013** Viña del Mar, Chile



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# Proceedings of the 7th International Fisheries Observer and Monitoring Conference

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the collaboration of the Scientific Steering Committee*

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- International Pacific Halibut Commission
- Ministry for Primary Industries (NZ)
- Satlink

## The 7<sup>th</sup> IFOMC International Steering Committee

The Steering Committee was instrumental to the success of the 2013 conference. As pictured below, the members are (left to right)



Francisco Plaza | *Conference Coordinator, IFOP - Chile*  
Howard McElderry | *Archipelago Marine Research Ltd., Canada*  
Greg Workman | *Fisheries and Oceans, Canada*  
Andrew France | *Ministry for Primary Industries, New Zealand*  
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Luis Cocas | *Undersecretariat for fisheries and Aquaculture, Chile.*  
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Charles Grey | *NSW Primary Industries Science and Research, Australia.*  
John Chouinard | *Fisheries and Oceans, Canada*

## Executive Summary

The 7<sup>th</sup> International Fisheries Observer & Monitoring Conference took place in Viña del Mar Chile on April 8- 12, 2013. It convened 27 countries and more than 250 participants. This meeting, as in the past, was able to make space for discussion, sharing of knowledge and most important reunite old, new and future Scientific Observers, researchers, government entities, industrial, and institutional representatives. The primary objectives of this meeting were as follows:

- *To develop, promote and enhance effective fishery monitoring programs and use of technologies to ensure sustainable resource management throughout the world's oceans.*
- *To improve fishery monitoring programs worldwide through sharing of best practices and development of new methods of data collection and analysis.*
- *To provide a forum for dialog between those responsible for monitoring fisheries and those who rely upon the data they collect.*

The conference consisted of 12 Session Themes ranging from topics such as “New and Emerging Observer programs” to “Monitoring of Artisanal fisheries”. Three workshops: Data Quality, Observer Professionalism and Observer Bill of Rights Workshops.

The Conference’s International character caught much interest amongst government entities and local authorities. Speeches from Head of Fisheries Administrative Division Maximiliano Alarma, Fisheries Development Institute Executive Director José Luis Blanco, Municipal Communications Director Wladimir Espinoza in Representation of Viña del Mar’s mayor and Chairman Oscar Guzman were held at the Official Opening Ceremony.

During the course of the week, panelists discussed current trends and issues affecting observer professionalism allowing a constant interaction between panelist, session leaders and spectators.

Delegates also participated in artistic events, cultural activities, and social spaces geared to global and regional networking and alliance building. The conference finalized with closing remarks from Gabriel Blanco, Lisa Manarangi-Trott, Omar Yañez and Chairman Oscar Guzman.

## Conference Session Summary

### **Session 1: How to balance cost effectiveness of data quality in fisheries monitoring programs?**

This session was focused on exploring successful applications of cost saving strategies to maximize the effectiveness of fisheries monitoring programs. In a world of limited budgets and increasing demands for monitoring, what approaches have programs taken to get the “biggest bang for their buck”. Strategies to prioritize critical needs over less essential ones, focusing on objectives, fine-tuning equipment, and developing alternative systems need to be continually performed and evaluated. This session had five talks by four speakers from four observer programs around the world offering some of their recent lessons learned to target an optimal yield of monitoring resources. We heard from Gabriel Blanco, Craig Faunce, Eric Brasseur, and Bob Trumble, led by Amy Martins (formerly Amy Van Atten).

Gabriel Blanco from the National Institute of Fisheries Research and Development (INIDEP) in Argentina kicked off the session with a talk on a software system, “OPTIMOBS v3”, designed to optimize the use of observers through quantitative planning. With 520,000 square nautical miles and 700 different types of fishing trips, this presents a challenging landscape for fisheries management and this program is applied to help develop a coverage plan based on previous years’ fisheries data. This tool has proven helpful in decision making for the program and has helped to optimize observer coverage. Gabriel also reported on using a Monte Carlo Simulation to help inform how many observers would be needed to provide adequate distribution of coverage in a stratified fishing fleet. This further helps to inform the optimum application of observers for particular fishery characteristics.

Craig Faunce, with the National Marine Fisheries Service, from the Alaska Fisheries Science Center, talked about applying an audit approach to improve catch reporting in Alaska. Using ratio-estimators to generate landings estimates, he reported on a comparison between observer reports and industry’s in an effort to improve the overall quality of the catch accounting of three fisheries in the Gulf of Alaska. He suggests that observer data can be used to audit the self reports. He tested the quality of the observer data as well and found that on occasion rare catches may not be detected and species identification may present some problems. He highlighted that by using shore-based observers, in addition to at-sea observers, has utility in improving species identification on landing reports, thereby improving the overall catch accounting particularly under multispecies complexes.

Eric Brasseur, with the National Marine Fisheries Service, with the West Coast Groundfish Observer Program presented data on cost benefits of investing in quality sampling equipment for observers, resulting in higher quality data and long term savings. Their program has invested in purchasing a more costly scale, but the value it brings to collecting better quality information on weights of fish at-sea is worth the investment. In the evaluation of new equipment, the safety of observers was also evaluated, and the long term durability in the field. His field study demonstrated that the addition of the motion calibrated platform scale increased accuracy, reliability, efficiency, and observer safety.

Bob Trumble presented some suggestions of guiding principles in designing fishery monitoring programs. These were organized into eight inter-related categories, highlighting the importance of getting stake holder engagement and support, understanding the specific fishery fleet characteristics, establishing clear goals and objectives of the monitoring program, making enforcement considerations, and developing monitoring strategies. By developing and clearly articulating these in advance of deploying a monitoring program, a more effective and efficient program will evolve. MRAG Americas convened two panels with experienced program managers and they put these best practices, or guiding principles, in a document to help guide developing programs, and serve as important reminders and considerations for existing monitoring programs.

In summary, this session had some good examples and shared innovative ideas of how to polish, improve, evaluate, and perfect the management of monitoring programs. These examples included documented principals, developing software for optimizing deployments, adjusting sampling strategies, and investing in appropriate tools for success. These are all efforts to balance the costs and resources with measured improvements in data quality. We don’t want cuts in budgets, or increasing demands for more coverage with less resources, to degrade the quality of data or the

safety of observers, and these are important studies to share and replicate or apply to other monitoring programs to maximize the value of these critical data.

### **Session 2: Can industry data be used for monitoring rights-based fisheries, seafood traceability and/or fisheries certification?**

The fishing industry is becoming increasingly proactive in the management and monitoring of its activity, resulting from the need to increase accountability pushed by non-governmental organizations but also by consumers. Industry run programs can be cheaper and more efficient, giving at the same time the industry empowerment to be more engaged and cooperative. The objective of this session was to give an overview of different industry monitoring programs that were used or started because of management, seafood traceability or fisheries certification needs.

A wide diversity of papers were presented, addressing the several topics asked for, from industry owned and run observers programme to self-sampling and reference fleets, and their connection to research-based programmes, but also the importance of market forces to incentive monitoring programmes through sustainability certifications and supply chain traceability projects. The session attracted speakers from three continents: Asia, Europe, America (North and South); and included representatives from several stakeholders groups: non-governmental organizations, industry and researchers.

Following the presentations several topics were discussed, ranging from the reasons behind industry lead programmes, such as permission to fish in specific areas, with distinct gears or for different species, but also the need to demonstrate different sustainability requirements. Questions such as how to ensure industry data quality and verification, how transparent and accessible are industry data to the general public, or how data may change with different legal requirements were discussed, among other issues. It was generally agreed that there is an important role for the industry to play in monitoring programmes. The answer to the initial question “can industry data be used for monitoring rights-based fisheries, seafood traceability and/or fisheries certification?” was an unequivocal yes.

### **Session 3a: What are the future trends in fisheries monitoring programs?**

Trusted, timely, and accurate catch information is critical for maintaining sustainable fisheries, but this is often difficult and costly to obtain. For many fleets, observer-based monitoring programs may be too expensive, impractical, or logistically complex. As a consequence, there is interest in exploring technology based approaches to monitor fisheries, based on the notion that this may be a more cost effective and practical option. Electronic Monitoring, an automated array of closed circuit television cameras and sensors, has been tested in a variety of fisheries across multiple jurisdictions, geographies, gear types, catch and monitoring objectives. Many of these studies show promise, yet after over a decade very few fisheries have adopted technology-based monitoring, suggesting that there are challenges in getting traction with this approach. The purpose of this session is to examine different test cases to better understand implementation issues and lessons learned. It was emphasized that EM should not be considered as a replacement for observers, but rather to serve as an additional means of collecting data. Observers will always be needed in some capacity, such as collecting biological specimens and detailed catch sampling.

As a preface to the presentations, the session lead provided an overview of EM technology, summarizing the elements that would likely be in common with any EM program. Firstly, there is an onboard monitoring system consisting of a control center, to record data, connected to an array of video cameras, gear sensors (e.g., winch, hydraulic pressure), and a GPS receiver. The entire system is then powered through the vessel’s AC or DC power. The system runs automatically when activated, mapping the cruise track, logging fishing times and locations, monitoring winches, pumps and lifts, and creating a video record of all key fishing operations. Secondly, data analysis software is needed to help summarize and review the large quantity of data recorded by the EM system. The analysis tool is used to efficiently review, evaluate, and report on fishing activity. This tool integrates thousands of video, sensor, and GPS records into a single synchronized profile, so reviewers can quickly review trip cruise tracks, verify gear deployment and retrieval times and locations, and verify catch events. Key fishery data can then be recorded in a standard database format for easy reference, analysis, or downstream processing. Finally, surrounding the technology is an operational framework that includes clearly defined fleet and vessel monitoring plans to ensure the technology is deployed successfully, field service infrastructure to manage the EM equipment deployed, data analysis services to interpret, integrate and report EM data, as well as other service elements to ensure the program is efficient, effective, and integrated with fishery agency needs.

There were seven panel presentations covering a range of topics related to planning, implementation and testing of technology-based monitoring. The presentation by Ms. McTee provided a planning tool for thoughtful assessment of monitoring needs and selecting of the appropriate monitoring tool. Mr. Rilling provided an interesting perspective on US fisheries agencies as they move to improve their fishery dependent data systems and consider how EM could play a role. Mr. Dalskov summarized the Danish experiences with EM and a fully documented fishery program that has been deployed since 2008 in the North Sea. Based on a large multiyear Scottish EM program, Ms. Dinsdale developed a cost model for use in comparing EM with observer programs. Mr. Chamberlain (presented by Ms. Van Atten) reviewed their progress with an EM trial in the US northeast multispecies groundfish fishery. Mr. Chavance (presented by Mr. Ruiz) presented results from high seas Indian and Atlantic Ocean trials on large pelagic tuna seiners, while a small vessel application was presented by Mr. Baker, with results from the US southeast snapper fishery.

The presentations and follow on discussion provided a range of perspectives on the use of EM to monitor commercial fisheries. Clearly, EM is not a 'plug and play' replacement for observer programs and technology-based systems are complex, time consuming to implement, and required greater crew cooperation for success. Even the most optimistic scenarios of EM deployment in a fishery could still require observers to fulfill some of the more detailed data collection needs. However, there were several examples provided of ways EM could be deployed in an effective manner. The potential cost savings from technology based monitoring provide a compelling case to continue examining potential applications.

### **Session 3b: What are the future trends in fisheries monitoring programs?**

In the United States, when one mentions electronic monitoring (EM) thoughts lock onto video. However, EM can include other electronic technologies such as electronic logbooks (E-Logs), handheld devices for data entry, and data collection software. To that point we have heard how in Peru, the use of an onboard electronic logbook, Logbook t, collects fishing effort data consistent with an ecosystem based approach to resource monitoring.

As a compliment to Peru's efforts of using electronic technology to monitor fisheries, we have heard how Fisheries and Oceans Canada (DFO) has successfully deployed E-Logs since 2005 in a variety of fisheries, gillnet, trawl, pot, and hook and line. Using satellite modems, smartphones, or local area networks, data can be transmitted in near real time, if necessary. Programming in HTML 5 has made it easier to use this application on smartphones. This innovation makes it easier for the recreational fishers to report their catch information and adds another option to observers on recreational boats to collect data. It has also led to reductions in costs and errors associated with transferal of hand written paper logbook data. Additionally, DFO's First Nations (FN) has access rights to fisheries above those of commercial and recreational fishers. We have also heard how DFO has developed a Regional Food, Social, and Ceremonial (FSC) Standalone Database, which is designed to use FN fisheries programs to assist in the management of FSC catch data, fish requests, and distribution to members. The system interfaces seamlessly with DFO's corporate database thereby providing an effective standardized method to manage FSC catch data.

The United States Shark Bottom Longline Observer Program wanted to improve data collection. Using handheld computers, they designed data entry applications for observer to record and edit gear, haul and catch information that could be transferred via Wi-Fi hotspots. Use of the tablet and the IP67 case are cost effective. This is realized by the reduced number of hours required during post trip data transfer, making this paperless data collection method very attractive and feasible on a national level.

Possibly the most intriguing attempt to assess the total retained fish in a codend is being achieved by the several companies using a technology based on geological and geotechnical mapping called Sirovision. This approach could create accurate 3D images of total volume and once enhanced with image analysis algorithms could potentially identify individual fish and estimate their size. Acquiring these images coupled to GPS to georeference the data onboard with vessel specific data, e.g., vessel id, date, latitude, longitude, and total volume which could then be transmitted to a centralized database with minimal personal or infrastructure.

It should be noted that while we are all in agreement that the need for high quality data that is more readily available and cost effective to collect and transmit is a shared goal. It is further noted that we recognize observers as our eyes and ears into the fishing world. The application of the various electronic technologies shared here are intended as means to augment at-sea data collection methods, i.e., observers, and by no means as a replacement, this is a sentiment shared by everyone on this dais.

#### **Session 4: How do programs observe and monitor artisanal fisheries?**

This session focused on the main problems related to the monitoring of artisanal fisheries and management areas. In the first presentation, authors agreed that the difficulties of artisanal fisheries monitoring rely mainly on the diversity of fishing systems and gears, measures of sampling effort, wide geographical distribution of fishing effort, size and operation of each boat and most important crew skills. They all add up to a high amount of variables difficult to manage.

The presentation by Liliana Rendon "Observers of the voluntary program of the artisanal fisheries in the Eastern Pacific Ocean: Agents of change" mentions the development of a monitoring pilot study. The author agrees that it is possible to implement a monitoring system to artisanal fisheries but depends on its long-term financing.

Chile's artisanal fisheries monitoring plan as described in Nancy Barahona's presentation, has been operating for a long period of time, however its limitations rely mostly on achieving precise numbers to standardize the fishing effort. Crew competencies and the observers' skills are also key to a correct performance of the data system.

Robert Trumble's "A pilot study for observing Usui catch of the small boat fleet" mentions an alternative data collection system applied when financial, space, and safety considerations for placing observers on board are limitations to data collection. Therefore, the pilot study focuses on sampling fishing landings. Establishing this type of program will depend on the level of bias.

Managing marine coastal protected areas (TURF) face similar issues. Baseline studies are carried out by consultant enterprises, who then determine commercial catch quotas for resource exploitation. So again, we rely on the reliability of third party. The presentation by Luis Ariz shows that there are errors in the spatial location of the areas boundaries, and sampling units, caused by not using standard protocols for spatial data sampling (misuse or unreported datum).

There is the need to seek for methods to reduce these sources of error. One option is raised by Mr. Lima-Green with his proposal "New Statistical Method of Monitoring Artisanal Fisheries in Brazil" which proposes a three-phase method for monitoring artisanal fisheries. Unfortunately he could not participate in this conference but certainly can be a contribution for future sampling programs.

#### **Session 5: How best to monitor recreational and pay-for-hire (charter) fisheries.**

Commercial fisheries have a long history of being monitored and observed and this has led to the successful management of fish stocks and fisheries in many parts of the world. Recreational fisheries on the other hand, do not have such a strong history of being monitored, particularly in marine waters. There are of course exceptions to this statement, such as in North American freshwater lakes and rivers. It is now acknowledged that recreational fisheries are a significant component of the catch and take of many stocks in many regions of world and that recreational fisheries do indeed have an impact on world fisheries take.

Recreational fisheries are very lucrative in many areas, they often attract large numbers of participants and they are increasing in many areas. Recreational fisheries require rigorous monitoring and there is potentially an important role for fisheries observers to participate in this monitoring requirement.

This was the first introduction into this particular forum of a session focused on the monitoring of recreational fisheries.

In particular, this session aimed to investigate:

- How best to monitor and observe recreational fisheries
- How to incorporate with monitoring of commercial fisheries in shared stocks
- The impact that charter or head boats can have and the most effective means to gather the required information from these fleets.
- Develop methodologies to deploy observers into recreational fisheries

Worldwide, recreational fishing involves large numbers of people and is one of the most frequent leisure activities. Some success in gathering information has been achieved in some areas, primarily through interviewing fishery participants or having them complete surveys. The questions which were posed to fishers needed to be carefully worded to avoid bias to the survey respondents' feedback. With the increase in accessibility and adoption of internet based systems fishers are able to report their information via the web and there is a potential for more focus to be



directed in this area. All presenters during this session spoke of the difficulties associated with collecting the data and information required. The information need is there and over time we should see an increase in new and novel ways being trialed to collect the data needed.

#### **Session 6: Reducing risk in a high risk job.**

We see many of the same safety concerns and issues worldwide; unsafe vessels, lack of support, harassment, and a need for better safety training. We often think that our problems are unique, but many times other programs are facing similar issues and have come up with effective ways to approach them. This panel explored how RFMO's, observer programs, and observers themselves can mitigate some of these problems.

Our first presentation discussed how observers are in a unique position to gather information for fishery management organizations. Not only do they collect biological data used in fishery management, but they can collect information on safety standards and safety incidents. This information can be used to reduce the number of accidents and increase the safety for our fishing fleets worldwide.

The next presentation focused on an observer program in a remote area of Chile highlighting the difficulties, risks and safety concerns. Observer programs operating in remote areas often are the first and only source of data collected for these fisheries. Communication and information transfer between observer programs is increasingly more important with so many remote, small scale observer programs starting up around the world.

A talk on US observer safety trainings revealed many similarities and some differences. There is an emphasis for consistency between the trainings but with regional variations to address local safety concerns. Most agree that having national standards for safety training has many benefits. Among these are increase consistency, the possibility for observers to move between programs without added safety training, and a higher level of training.

A look at one program's safety checklist showed us a variety of required safety equipment as well as information that should be asked to increase an observer's safety. While no one safety checklist can fill the needs for all observer programs, all observer programs can benefit from having a pre-trip safety checklist. It was suggested that programs in need of a safety checklist review other program's checklists and glean what they can or modify to meet their needs.

The IFOMC is one of the few forums where observer trainers and managers from around the world can interact face to face. It is an opportunity to see what other observer programs are doing to reduce risk, increase safety and what can be incorporated into our own programs.

#### **Session 7: How to determine and reduce bias in monitoring programs?**

Bias can play a major role in observer monitoring programs and can drastically skew the reliability of scientific data. There are many types of inherent biases pertaining to marine fisheries data collection and analysis. This session discussed several examples of sampling or analysis bias and what procedures or methodologies can be employed to minimize them. Examples of potential sources of bias from observer programs include: vessel selection, catch sampling, changes in fishing behavior when an observer is or is not on board, and analysis techniques employed in the estimation of catch and bycatch. A diversity of papers were presented by authors from the U.S. National Marine Fisheries Service; Fisheries and Oceans, Canada, Université de Moncton, Moncton, New Brunswick; IAP World Services, and IMARES, Netherlands.

The first paper identified 3 types of bias that are related to observer data collection; mental and emotional bias, motivational and social bias. These types of bias can reduce objectivity throughout data collection and emergency situations. Solutions presented to reduce these forms of bias included random sampling in measuring of the catch, random vessel selection, the use of logbooks in debriefing, and annual safety drills. In another presentation, statistical analysis of landings and observer data noted observer data is likely to be unreliable for catch characteristics of commercially important species, but there is evidence that this may not be the case for some commercially unimportant species. Bias associated with the priorities given to observers and how well they can manage only so many tasks was also discussed in another presentation. Solutions were discussed during question and answer periods that included structural changes to observer programs that remove incentives for observer effects, creating disincentives and removing adverse opportunities.

Two papers presented bias associated with vessel selection. One paper suggested that continued selection of fishing vessels that had inexperienced Captains could unnecessarily influence the subsequent analysis of bycatch estimates. While most observer programs do not record information relative to the captain or crew's experience or fishing technique, results from this study suggest this data should be incorporated into future data collection protocols. Another presentation discussed a randomized deployment strategy that could potentially negate the possibility for observer data bias due to non-representative deployment in previous unobserved fisheries. The final two papers in the session examined simulation studies to evaluate how well observers on Dutch demersal beam trawlers collected data and the other on how haphazard monitoring of the Alaska groundfish fisheries can introduce harvesting bias. Both studies found bias but identified factors to reduce future effects in the associated programs.

#### **Session 8: Fisheries law enforcement roles in domestic and international waters**

The at sea observer program are used to collect technical, biological and scientific data. They are also used to collect all data related to the fishing activity (compliance monitoring). In some countries, at sea observers collect only biological and scientific data.

We are still faced with two schools of thought. Scientists do not want observers collecting data on compliance monitoring because this can influence the fishermen's behavior. Fishery monitoring experts, however, are entirely opposed to this approach and are requiring that biological data be collected at the same time as data on compliance monitoring.

For some time now countries have been forced to considerably decrease and adjust their means of surveillance at sea because of their increasingly precarious financial situations. Fishery managers are facing a considerable challenge: balancing the various tools that allow them to monitor fishing activities adequately.

Session 8 shed light on the increasingly important and necessary role that observers aboard fishing boats play in new initiatives, namely eco-certification and traceability. Both of these initiatives require governments in charge of fisheries to clearly show that they have effective tools in place to monitor fishing activities on a daily basis. The moment the fish are caught must be monitored, which requires observers to be on board fishing boats. These programs were implemented to put fish caught legally on the market, in accordance with the various regulations.

Having observers aboard fishing boats is a very effective way to identify illegal, unreported and unregulated (IUU) fishing within countries' exclusive fishing areas.

In the Canadian presentation on maintaining the integrity of the at sea observer program, the criteria adopted to avoid conflicts of interest between fishers, observers and at sea observer companies were identified. The Canadian objective is to have an observer program in place that provides reliable, integrated data on fishing activities. This data is used for both monitoring compliance with regulations and fishing plans and collecting biological and scientific data for stock assessments.

Mechanisms have also been put in place to audit at sea observers' work as well as that of companies responsible for delivering these programs.

New Zealand demonstrated that when observers are on board, fishers are better at recording compliance and fisheries information. Reviewing catch data from boats without observers compared to those with observers, the levels of non-compliance related to preparing reports and recording data on fishing activities is much greater when no observers are on board. Through compliance monitoring by observers, boats can be identified that are discarding and selecting large fish at sea because of catch limits they must comply with when they land. In some cases, up to 30% of unreported small fish catches were estimated using the data collected by observers.

The use of observer data for legal purposes must be rigorously controlled. Firstly, the Court must agree that the data can be admitted as evidence. Secondly, the credibility of observers must be debated in court. Thirdly, there is high turnover rate for observers, and sometimes it is difficult to locate them once they have left their job. In spite of this, during session 8 a few examples were given where observer data was used in court to sentence fishers.

During session 8, details were also presented on legislative measures adopted in Chile on recruitment, aid, at sea observers, and how they are treated on fishing boats and in processing plants. Since those regulations have been in force, changes have been noted in the quality and integrity of observer data.

Participants showed greater interest in the presentation on new measures within the Chilean law on discards. Numerous questions were asked about this new law, which did not seem to be overly accepted by harvesting industry representatives.

### **Session 9: What are the future trends of transshipment observer programs?**

The first tuna transshipment observer program (TTOP) was established in 2007 by the International Convention for the Conservation of Atlantic tuna (ICCAT) to monitor transshipments between large scale longline vessels and ICCAT authorized tuna transport container vessels for 4 member countries. The goal of the TTOP was to record the transfer of tuna from the fishing vessel to the container vessel and ensure that no product laundering occurred. While globally most observer programs have a scientific basic or core to their scope of work, the TTOP program was established solely as an enforcement or monitoring program. Quickly thereafter the establishment of ICCAT TTOP program, other RFMOs including the Inter-American Tropical Tuna Commission (IATTC), Commission for the Conservation of Southern Bluefin Tuna (CCSBT), and Indian Ocean Tuna Commission (IOTC) initiated similar transshipment observer programs. Recently the Western and Central Pacific Fisheries Commission (WCPFC) has also adopted a transshipment observer program.

The purpose of the session was to discuss similarities and differences between these spatially large global transshipment observer programs, identify areas that could be improved either across programs or individual programs and converse on whether these programs can collect good useable scientific data instead of only compliance information in the future.

Mr. Nugent provided a good historical review of the development of the various TTOP programs and the types of data they collect. Currently MRAG Ltd, Capfish and MRAG Americas are the providers of observers to ICCAT, IOTC, IATTC, and CCSBT. Because these companies are in partnership with each other, they share training materials and cross train observers in ICCAT, IOTC, and CCSBT. The cross training reduces training and administrative hiring costs as well as improving the efficiency of leaving TTOP observers on board the transport vessel once the vessel crosses into a new management area and accepts product. Mr. Nugent suggested improvements could be realized through greater integration of the IATTC and WCPFC programs.

Mr. Belay presented recent updates on the greater monitoring and data collection on the transshipment of sharks in the IATTC program. IATTC and other regional fisheries management organizations (RFMOs) are beginning to expand their information gathering requirements on bycaught species and their disposition such as shark fins.

Ms. Dietrich and the Association for Professional Observers (APO) created a survey directed at former and current TTOP observers that queried the observers on a variety of issues including hiring eligibility, criteria, and training length. Areas that need improvement are inconsistencies among programs on how data is collected (independently by the observers vs. data that is provided to them), length of observer deployment (8-10 months in one TTOP program), observers need safe and clean drinking water to be provided to them, and standardized protocols for identifying and recording vessel characteristics. The APO's study also provided many recommendations on where data could be collected consistently using the same protocols and forms across programs.

Mr. Altamirano discussed the similar data collection requirements for vessels that fish for tuna in both of the IATTC and WCPFC convention areas. The data requirements and associated protocols are determined by each of the RFMO organizations. There is one significant difference in data gathering requirements between the two programs. In the IATTC Eastern Pacific Ocean it is common practice to set on schools of dolphins that are associated with tuna. However this same practice does not exist in the WCPFC. The IATTC and WCPFC are in discussion about ways to harmonize currently data collection practices so that both RFMOs can extend data analysis across RFMO boundaries.

In summary, all of the presenters emphasized the need for greater data and protocol harmonization and cross training of observers. Standardizing protocols and creating standardized training materials, and data collection fields will allow researchers and managers to analyze tuna product and bycatch movement on a global scale to combat illegal fishing

and improve tuna management. Other aspect of the TTOP that could be improved include harmonizing hiring eligibility, payment practices, and length of observer deployments.

### **Session 10: How can Fishery Monitoring programs support an Ecosystem Based Approach to Fisheries Management?**

Over the last two decades government agencies tasked with managing fisheries have struggled with implementing an Ecosystem Based approach to Fisheries Management (EBFM) or rather a holistic and all-encompassing view of the resource extraction activity and its impacts. EBFM requires responsible agencies to not only collect information on landed catch of target species but also the composition and quantity of by-catch and discarded catch, habitat impacts and encounters with endangered, threatened or protected (ETP) species. Fisheries observers have been employed as the primary tool for collecting this information, observers allow agencies to collect high precision species specific data, both temporally and spatially throughout a fishing season resulting in incredibly rich data which provide insights into the biology, seasonal movements and life history of species vulnerable to the fishing gear as well as insights into fleet dynamics and fisher behavior.

The panelists for this session have covered a broad range of topics. Alex Perry discussed recent changes to the fisheries management system on the west coast of the USA and the adoption of Individual Fishing Quotas (IFQs) and 100% observer coverage as a mean of gathering the data required for analysts to provide ecosystem based harvest advice to resource managers and policy makers. Eric Appleyard discussed the pivotal role at sea observers play in collecting not only fishery data but also fishery ecosystem impacts data in Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR) convention area. Both of our first presenters discussed the need for information on fishery impacts on target and related species and emphasized the importance of at sea observers in gathering information on the gear configuration (including measures to reduce incidental mortality of seabirds and marine mammals), fishing operations, catch composition, biological data on target species including tag/recapture data and data on non-target catches including fish, seabirds, marine mammals and vulnerable marine ecosystems (VME) indicator taxa. Miguel Machete presented an overview of several projects in the Azores wherein observer data is used to verify fishing activities, evaluate fishing practices or generate estimates of total catch for several non-target species. These studies emphasized the scientific role at sea observers often play blurring the line between the observer as an enforcement entity and the observer as a sea-going scientist while further re-enforcing the need for, and utility of, objective, unbiased at sea observations of fishing activities. Our fourth speaker, Morales-Yokobori, presented a Productivity/Sensitivity analysis that relied exclusively of fisher logs contrasting the level of overlap between the fishing fleet and the species distribution for both target and non-target species demonstrating the utility of mandatory fleet wide Fisher logs (Fishing reports) for informing analyses across large geographic and temporal scales. Laurence Fauconnet explored the question of how fishing gear selectivity, across a range of gear types, results in different ecosystem level impacts in the Bay of Biscay. This is one of the few studies making full use of the detailed information collected by at sea observers by generating metrics of species richness and evenness from catch composition data and size selectivity from the length composition data. The final speaker, Carol Eros, presented a risk based frame work for determining appropriate levels and types of fishery monitoring based on the perceived levels of risk to ecosystem components (species, community or habitat). The framework affords a consistent and transparent approach to developing fishery monitoring programs in Canada's Pacific Region fostering greater confidence amongst stakeholders and the general public.

In jurisdictions with long standing fishery monitoring programs data collected by observers is increasingly being mined by analysts for insights into changes in ecosystem structure and function not only in response to fishing pressure but also in response changing climatic conditions. While many observer programs had their genesis as regulatory measures the information these programs have gathered over the decades is now proving invaluable in trying to assess the consequence of anthropogenic activities on marine ecosystems.

### **Session 11: New and Emerging observer programs**

There is no doubt that the critical condition of many fisheries around the world have resulted in a higher demand for finer data and information, needed to properly administrate the fishing resources and its environment. In addition, Governments have shown a growing interest in managing their fishing resources sustainably using an ecosystem approach, which involves taking into consideration a series of data not collected in the past, including discards, incidental catch, impact of oil spills, etc.

Through experiences presented at the 7<sup>th</sup> IFOMC, we have seen that Chile and the other participating countries are not the exception to this trend. However, in most places the availability of research vessels is both limited and expensive, making it necessary to incorporate fishing vessels and fisheries observers to the task of collecting the bulk of the information. Yet, the constrained conditions challenge to work and live aboard these vessels, and call for skilled observers, capable of performing a variety of tasks while maintaining good communications with the crews. This scenario makes indispensable to rely on appropriate training programs aimed to provide observers with knowledge and adequate tools. In addition, it has been recognized that it is essential to introduce changes in regulations as well, guaranteeing better and safer working conditions for observers.

As a result new and emerging observer programs are being implemented worldwide. An example illustrating the international commitment to improve fisheries management and conservation through observers is the South Korean National Observer Program, operated since 2004 by the National Fisheries Research and Development Institute (NFRDI). This program had accomplished high standard monitoring for ICCAT, CCAMLR, WCPFC, SEAFO, SPRFMO, and SIOFA, and has been continuously improved by the Government which has recently launched the Institute for International Fisheries Cooperation (IFIFC). At present, both agencies work collaboratively; NFRDI providing scientific support, and IFIFC dealing with administrative issues. In addition, the Government plans to amend the Ocean Industry Development Act, advancing toward a world-class level Program.

As said previously, observer programs have become versatile, taking significance in monitoring not only fishing activities but other marine economical activities that may impact the environment as well. Such is the case of the implementation of an emergency observer program as a response to the deep water horizon oil spill in the Gulf of Mexico in 2010. This incident demanded a quick reaction to monitor and recover specimens impacted. Once again, observers proved to be a great source of information. Nevertheless, setting a program under these conditions was a challenge in terms of training, safety, and logistics, which need to be considered for future experiences.

Also immerse in this global context of new requirements for information from areas of marine economic development (fishing, offshore oil and gas seabed resources, marine renewable energies, and tourism) we knew the case of Galway-Mayo Institute of Technology and the Strategic Alliance for Research and Training, who developed and provided accredited training for industry personnel and graduate students to collect data from all those commercial platforms. The training included shiptime, laboratory, and lectures supported by online resources providing trainees with the skills to collect data for variety local and foreign agencies.

Along with new data requirements we have seen changes in fishing regulations; shifting from the dependence on vessel owners' will to allow observers onboard, to more compulsory requirements. A clear example is the Chilean Regulations on Observers, first launched in 2006, and currently being improved through amendments in the Fisheries Act. In absence of appropriate regulations before 2006, the system relied strongly on fishermen involvement, which was accomplished through education provided to them by the observers. The monitoring of swordfish in Chile is an example of cooperative effort, showing the relevance of providing information to fishermen, who are now committed to conservation. This experience was the base to further develop the observer program under the new rules.

The 7<sup>th</sup> IFOMC corroborated the importance of having well implemented observer programs in order to achieve the complex task of managing fisheries worldwide and securing its sustainability. It was reach a consensus regarding the essential role played by fisheries observers within this approach, and it was also agreed the need to standardize these programs, improving training, working conditions, job stability, safety, independence and data quality.

The human component is transcendental and must be also considered. However, since observers work independently, and spend little time with each other, currently it has been limited exchange of experiences. Through OBSERVE THIS!, a unique and entertaining audiovisual initiative presented by a NOAA/NMFS observer, we have seen that unconventional tools may be of big help to illustrate these experiences, share valuable information, and above all, contribute to maintain positive working relations with fishermen. In addition, OBSERVE THIS! shows topics applicable universally, therefore may serve to promote professionalism and international exchange of experiences between observers worldwide.

As management systems evolve, observer programs must also adapt. In the U.S West Coast, where the limited entry trawl fleet was rationalized to a Catch Share system, the transition to an Individual Fishing Quota required the

implementation of a 100% observer coverage at sea and for landings, while maintaining coverage levels in a variety of other fisheries observed by the both the West Coast Groundfish (WCGOP) and Hake (A-SHOP) Programs. These new requirements impacted observer priorities, data timelines and other science objectives, as well as the workloads. The transition also involved challenges in terms of safety while achieving 100% coverage and finding cost-effective alternatives such as EM. These kinds of efforts require a collaborative work with other agencies, fisheries groups, programs and stakeholders.

A well-documented example showing how cooperative efforts can lead to accomplish transcendental scientific research for management and conservation, in a cost effective way, is the assessment of post- release survival of stripped and Pacific blue marlin by the Pacific Islands Regional Observer Program since 2010. The otherwise cost-prohibitive estimations of mortality, derived from logistic, experimental designs, amounts of samples, and material required for pop-up satellite archival tags, was remedied through a cooperative approach, which included the use of a cost effective biochemical technique, and well trained observers, directly linked to the researchers.



7<sup>th</sup> IFOMC 2013  
Hotel O'Higgins, Viña del Mar, Chile

## Opening Session

The opening ceremony of the 7<sup>th</sup> IFOMC took place on the evening of Monday, April 8, 2013 in Hotel O'Higgins plenary room. The Opening Session included welcoming speeches from Chairman - Oscar Guzman, Municipal communications Director - Wladimir Espinoza, Head of Fisheries Administrative Division SUBPESCA - Maximiliano Alarma, IFOP Executive director – José Luis Blanco and Senator Antonio Horvath.

### Welcoming Remarks from Chairman Oscar Guzmán.



On behalf of the Scientific Committee I would like to welcome you to the seventh edition of this conference. No doubt it's an honor for us to have a large presence of observer monitoring program organizations, members of Chilean government, NGO's, academics and other stakeholders that despite the great distance have made every effort to be here. This not only highlights the importance of these meetings, but also gives us the assurance that we are on the right path towards an improvement of observer and monitoring programs worldwide.

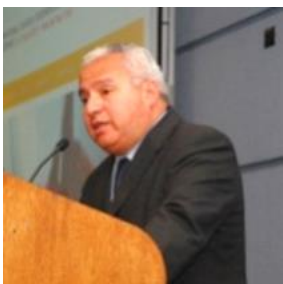
I wanted to take the time to introduce the Scientific Committee. Please welcome our members from the United States, Teresa Turk, Dennis Hansford, Amy Van Atten, John LaFargue and John Carlson. From Canada, Howard McElderry, Greg Workman and John Choinard. From Portugal, Lisa Borges. From New Zealand, Andrew France. I would also like to introduce you to Mr. Luis Cocas, our Chilean representative in the Scientific Committee

In the last couple of years we have developed a program for the 7th IFOMC, continuous to the main aims of past meetings, highlighting and emphasizing on the development of innovative methods to monitor our fisheries and how to globally promote the use of these.

The conference is setup of 12 sessions. Oral presentations will be held at our main conference room and posters will be permanently located at the Esmeralda Hall. Two very important workshops will also take place at our main conference room O'Higgins.

No doubt that during this week, we'll have room for discussion, sharing of new experiences and have a closer view of the different observer programs around the world.

## Welcoming remarks from Wladimir Espinoza – Municipal Communications Director, Viña del Mar, Chile.



I am pleased to give you all a warm welcome and thank you on behalf of the Mayor of our city Mrs. Virginia Reginato, for choosing Chile, especially Viña del Mar, to host the Seventh International Fisheries Observer & Monitoring Conference.

The IFOMC is being held for the first time in Latin America and has the participation of over 180 delegates from 27 countries. The first version was hosted in 1998 in Seattle, United States, and later on in countries like Canada and Australia.

A special recognition goes to the Fisheries Development Institute for hosting this important event of global significance, which seeks to create a solid foundation of knowledge for countries to manage their natural resources towards a sustainable development of fisheries.

As a coastal city that coexists directly with the sea, we hope that this conference can be a great contribution to continue with the goals set in the industry, providing its participants with the knowledge and necessary tools to ensure the sustainable management of the world's oceans natural resources.

In parallel, we invite attendees from this important conference to discover and enjoy the benefits of our city. Our tourism, historical attractions and spectacular surroundings makes us the epicenter of Chile.

## Welcoming Remarks from José Luis Blanco – IFOP Executive Director



I have the honor to welcome you on behalf of the Fisheries Development Institute to the 7<sup>th</sup> International Fisheries Observer and Monitoring Conference. I am particularly proud that you chose Chile as the host of your meeting and hope that you find here the necessary conditions for a profitable work.

During the next few days, you will be devoted to a problem of great importance for the future of fisheries. Our world's oceans are at high risk, the high level of resource exploitation is causing a negative global effect. Within the general framework of sustainability of fisheries, protection of endangered species is a major task.

Fisheries Observer Programs are one of the main tools for acquiring first-hand scientific information in fisheries research. Fisheries Observer Programs are considered, along with satellite tracking systems for vessels and fishing research surveys, key tools for achieving sustainable management of fisheries resources.

Undoubtedly, this Conference deemed necessary to review, among other things, the functions and activities of the Fisheries Observer programs already positioned on our globe as well as strengthening developing programs.

Ladies and Gentlemen, I thank you as well as all the international organizations represented here, for the hard work and your dedication dispensed inexhaustibly in the cause of protecting our future.

I wish you a pleasant stay in Viña del Mar.



## Welcoming Remarks from Maximiliano Alarma – Head of Fisheries Administrative Division. Undersecretariat for fisheries and Aquaculture, Chile.



First of all I would like to extend to you the warm greetings sent by our Under Secretary for Fisheries and Aquaculture, Pablo Galilea Carrillo, both to the Fisheries Development Institute, organizer and host of this event, as to all delegates from the 27 countries with us today in the 7th International Fisheries Observer & Monitoring Conference.

For the Under Secretary of Fisheries and Aquaculture, it is an honor and a great opportunity that our country is hosting the first IFOMC held in Latin America, mainly because we find ourselves at a historic moment in the management of our fisheries, corresponding to the implementation of the new Fisheries and Aquaculture Law enacted on February this year. This law has radically changed the prevailing scenario, incorporating the precautionary principle and focusing on ensuring the sustainability of fishery resources and establishing scientific criteria for over all other considerations when making management decisions and management.

Another example which plots the change is the new law that defines and regulates discard, which requires us to study this practice, quantify, identify the causes of discards, know where it happens and in what fisheries is it more relevant to finally establish a Reduction Plan. All information on discarding Research Program will be collected by scientific observers deployed throughout the country in selected fisheries.

Also, the new Fisheries Act has given IFOP the custody and administration of all databases generated in research activities and monitoring of fisheries and aquaculture. To gather the information at a single institution, demonstrably capable of so much work will certainly help us in fulfilling our task.

Chile has the great challenge of recovering their fisheries and it is therefore essential to have reliable data on what actually happens on board industrial vessels, in fish processing plants and artisanal fisheries. Quality data are the basis of modern fisheries management. If the information contains errors it will introduce uncertainty in the scientific advisory which will then lead to a misdiagnosis in the state of the resource, and therefore not allow for good decision making in fisheries management.

The common feature observed in countries that have successfully addressed and resolved the problems associated with fisheries management, is that they have monitoring programs and scientific observation of wide coverage and high standards, which ensures the representativeness of the data. The international experiences that we collect on this matter will help achieve the goals we have set.

As I mentioned above, new fishing regulations require a major role to be played by the Scientific Observers. The regulations recognize that the best source of information on fishing activities and what actually happens in the sea comes from observers, and in that sense it has sought to ensure that safe working conditions comply with appropriate standards and ensure a good performance of observers' duties.

Needless to say and appreciating the great efforts that many of you have made to come to this distant corner of the planet, I say goodbye, wishing that your stay is pleasant and that we can work together for the sustainability of the oceans.

# SESSION 1

## How to balance cost effectiveness of data quality in fisheries monitoring programs?

Session lead: Amy Van Atten | NOAA/NMFS, USA  
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### Session Description

With stringent quotas and bycatch limits, the need for robust monitoring and sampling programs continues to grow along with the demand for timely, accurate assessments in catch, abundance, and impacts of fishing. Collecting information at-sea onboard fishing vessels can be expensive and observer coverage requirements are often cut short due to funding limitations. In designing new or improving existing monitoring programs, what examples are there of applying successful cost-savings without sacrificing statistical value and compromising safety and how has this affected fishing vessels and coastal communities. This session explored how programs have balanced the budget without slashing quality.

### Panelists

#### OPTIMAL COVERAGE PLANNING FOR FRESH FLEET OF ARGENTINIAN HAKE (*Merluccius hubbsi*) WITH OBSERVERS ON BOARD FOR THE YEAR 2013



Blanco, G., Aubone, A., Rodríguez, J. D., Atri, W.

Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), Argentina.

#### Introduction

Since 1984, the INIDEP's Program of Fishing Observers on Board has started to estimate total catch, fishing effort, discards of fishery resources (including the unprocessed bycatch) and the length structure of catches.

The Argentinean Continental Shelf is a large area covering 520.000 square nautical miles. More than 700 different types of fishing ships work in this area (artisanal, freezers, outriggers, jiggers, long liners, etc.) and have diverse target species. Up to 500 of these ships have satellite monitoring systems.

This situation presents a challenging landscape for researchers and for fisheries stock management. In this work we develop a coverage plan to place observers on board for year 2013 using data from 2010, 2011 and 2012 obtained by observers of the fresh fleet that operates on Argentinean hake (*Merluccius hubbsi*). Moreover, we compare this plan with the effective coverage in year 2011 and we conclude the current 2013 coverage plan is optimal for observers.

The calculations were conducted using our own program OPTIMOBS v3. The quantitative planning of number of observer on board using historical data and the methodology developed, allow us to obtain a plan that will be based on data and will be efficient.

### Methods

Here we show the results from previous work on determining the optimal number of observers. The data from fishing logbooks were combined with data from satellite monitoring which fed the input file OPTIMOBS v3 SOFTWARE. Simulations suggest the number of fishing days to be cover. This translates in number of observers.

This study was developed along the Argentinean Continental Shelf. The data is from Argentinean “hake ice trawlers fleet” that is composed of different category of ships (HP: 290-2000) and operate with trawl nets. The fleet is subdivided into four categories according to HP<sup>1</sup>.

Category	Power (HP)	Range	Length (m)	Range
I				
+	290 to 699		20 to 38	
II	700 to 899		25 to 65	
III	900 to 1399		32 to 60	
IV	1400 to 20 00		41 to 60	

**Table 1.** Categories of Argentinean hake ice trawlers fleet.

Data were taken from the annual position files reported by the monitoring satellite system. The vessel data registries were filtered to vessel speeds within 2 to 5 knots (speeds that represent fishing activity). Each record was associated to recorded positions on the respective fishing logbooks forms and arranged in “statistical squares” to obtain the frequencies (spatial and for each fleet category).

Four time periods were defined, taking into account the spatial distribution of hauls (January-March, April-May, June-August and September-December). April-May and June-August are the two time periods with more spatial dispersion of hauls. Those years represent a similar dispersion of hauls by period. The participation of each category from the fleet was uniform within the different periods of each year.

The Optimality criteria for the minimum number of observers for coverage to adequately rebuild the:

1. Observed spatial distribution of hauls
2. Observed fleet category distribution
3. Number of hauls to be observed requires a minimum of 10% of total catch by the fleet

### Results / Discussion

The final results of the minimum number of trips to be observed depends on the availability of resources to boarding and the objectives of coverage among others including (the maximum allowed error and the minimum percentage of coverage of the declared catch). This paper considers the inter-annual variability to define more robust coverage plan. The weight assigned to each scenario, taking into account the availability of human resources, is able to vary the results. The development of this work generates an important tool to be used in decision making, thus optimizing the observer coverage.

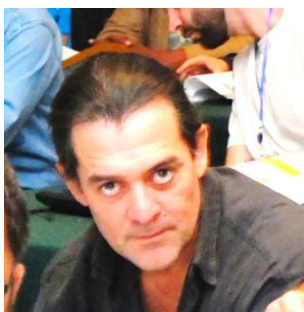
PERIOD JAN – MAR										
Hauls	Total days	Days by fleet category				% Catch	% Hauls	Spatial Rep.	Fleet Rep.	
		I	II	III	IV					
<b>1150</b>	<b>335</b>	<b>143</b>	<b>51</b>	<b>82</b>	<b>59</b>	<b>0.1060</b>	<b>0.1063</b>	<b>1.0000</b>	<b>1.0000</b>	

<sup>1</sup> Irusta, C. G., Castrucci, R. y Simonazzi, M. 2006. Desembarque, esfuerzo y CPUE derivados de la flota fresquera argentina dirigida al recurso merluza localizado al norte de 41°S. Período 1986-2005. INIDEP. Inf. Téc. Int. 5/06:31pp.

<b>PERIOD APR – MAY</b>									
Hauls	Total days	Days by fleet category				% Catch	% Hauls	Spatial Rep.	Fleet Rep.
<b>600</b>	<b>192</b>	<b>61</b>	<b>25</b>	<b>68</b>	<b>38</b>	<b>0.3600</b>	<b>0.1313</b>	<b>1.0000</b>	<b>1.0000</b>
<b>PERIOD JUN – AUG</b>									
Hauls	Total days	Days by fleet category				% Catch	% Hauls	Spatial Rep.	Fleet Rep.
		I	II	III	IV				
<b>600</b>	<b>221</b>	<b>78</b>	<b>21</b>	<b>69</b>	<b>53</b>	<b>0.4480</b>	<b>0.1390</b>	<b>1.0000</b>	<b>1.0000</b>
<b>PERIOD SEP – DEC</b>									
Hauls	Total days	Days by fleet category				% Catch	% Hauls	Spatial Rep.	Fleet Rep.
		I	II	III	IV				
<b>900</b>	<b>258</b>	<b>105</b>	<b>34</b>	<b>65</b>	<b>54</b>	<b>0.1359</b>	<b>0.0543</b>	<b>1.0000</b>	<b>1.0000</b>

**Table 2.** Distribution of sea days per period and per fleet categories resulting from OPTIMOBS v3.

## NEW METHODOLOGICAL ADVANCES IN DEVELOPING A PLAN TO OPTIMIZE FISHING FLEET COVERAGE WITH OBSERVERS ON BOARD



Aubone, A., Blanco, G., Rodríguez, J.

Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), Argentina.

The methodology developed in this work is based on obtaining some indicators of "good coverage by observers" through a Monte Carlo Simulation process. The goal of this work is to determine the minimum number of observers on board of a fishing fleet (may be a stratified fishing fleet), in a certain time unit capable of achieving an adequate spatial and fleet distribution reconstruction, a minimum percentage of the observed catch relative to the overall catch declared, and a good reconstruction of the length structure of catches. An adequate reconstruction is obtained when a great probability to reach these objectives is estimated. A program called OPTIMOBS v2013 was developed for this calculus. The number of observers calculated on board, allows to develop an optimum plan of coverage by observers, representative to these objectives, the historical data bases and also efficient.

## A FIELD TEST OF AN OBSERVER-AUDIT APPROACH TO IMPROVE CATCH REPORTING IN ALASKA



Faunce, C. <sup>1</sup>, Cahalan, J. <sup>2</sup>

<sup>1</sup> NOAA/NMFS, USA.

<sup>2</sup> Pacific States Marine Fisheries Commission.

The management of fisheries requires that the identity and quantity of fishing mortality be known. In Alaska, both retained and discarded portions of the catch are deducted from quotas set by the North Pacific Fishery Management Council (NPFMC). For catcher vessels, the retained catches used in management are those reported on landing reports (e.g., fish tickets). Estimates of at-sea discards are generated by multiplying the discard rate derived from at-sea observer data and the total retained catch from landing reports. The quality assurance of at sea catch information is enhanced by the presence of an observer compared to that of landing reports that are not currently monitored for accuracy in species identification by shore-based observers. We conducted a cooperative study to test whether species composition data collected by observers at shoreside processing plants could be used to verify the species composition of the delivery weights of catch that are reported on fish tickets. Observers were deployed to sample the delivered catch from within three fisheries of the Gulf of Alaska. Ratio-estimators were used to generate observer sample-based estimates of delivered catch from each landing. We examined the probability that observer estimates derived from the same population of catch in the landing report under the assumptions that the observer identification was correct and the landing report represents a census without error. Results highlight the utility of using shore-based observers to improve species-identifications on landing reports, especially for species that are currently managed as complexes.

## THE BENEFITS OF THE HIGH INITIAL INVESTMENT IN QUALITY SAMPLING EQUIPMENT RESULTING IN LONG TERM SAVINGS AND HIGHER QUALITY DATA



Brasseur, E., Benante, J.

NOAA/NMFS, USA.

Observer programs are under pressure to return data faster and in greater quantities while improving data quality with minimal budgets. The West Coast Groundfish Observer Program (WCGOP) experienced this recently with the implementation of the Catch Shares Program in January 2011. The proper choice of sampling equipment and data collection devices is integral to meeting these demands. The WCGOP made a substantial investment in electronic gravity compensating balances in 2010 in preparation for the transition to Catch Shares. Analysis of cost estimates extended over the long term show a reduction in overall costs while substantially improving the quality and consistency of weight measurements. Similar choices have been made to obtain high quality, long lasting equipment that will reduce costs over time when properly managed, tracked and maintained, and have the potential to increase the reliability and accuracy of data, and/or increase safety for observers. As an example, manual platform balances capable of weighing up to 150 pounds on an open deck cost approximately \$940 and have a life span of 1 to 3 years with good maintenance. High quality stainless steel, marine, motion compensating scales cost approximately \$6000 and have a lifespan of 20 years or more, with regular maintenance. Projecting the cost of purchases and maintenance out 20 years, a program can see a cost savings of -10% to 11% or more depending on how the service plan is structured, while improving the quality of data. One of the challenges of using a manual scale in a marine environment is obtaining accurate measurements. The angle of the deck, motion of the vessel, sea state, a limited ability to calibrate at sea, and the observers experience compensating for these variables while reading a constantly moving balance have a huge effect on the accuracy of any weight data collected. A small comparison study was done using actual fish weights and calibrated weights. Examining the 127 individual readings on each scale for the calibrated weights only, under variable seas states (max Beaufort 3), the electronic balance was 99.95%

accurate while the manual scale achieved only 99.18%. Both levels of accuracy are obviously acceptable however the resulting differences in total weight reported were -2.66 lbs. and -43.79 lbs. respectively. When projected out to multiple hauls and trips this quickly shows a trend to under report using manual balances as read by this specific observer. By utilizing the electronic motion compensating balance we remove some potential human error, compensate for sea state and achieve a much higher accuracy in reported weights. Additionally the observer is able to work much more quickly when using an electronic scale, resulting in less time spent on deck, thus reducing the safety risks to the observer as well. This is only one example of utilizing technology to assist observer programs.

## GUIDING PRINCIPLES FOR DESIGN OF FISHERY MONITORING PROGRAMS.



Trumble, R.  
MRAG AMERICAS.

Fisheries comprise a key aspect of changes in marine biodiversity. Successful fishery management requires reliable monitoring and reporting components, yet many fisheries have struggled to achieve effective monitoring programs. Without a well thought out monitoring design, the monitoring systems will unlikely address ecosystem information needs while still providing data for traditional stock assessments and other needs. Many monitoring programs in place today have evolved haphazardly over time. High costs of monitoring programs have presented challenges to implementing comprehensive monitoring programs. Lack of stakeholder participation often leads to poorly accepted programs that do not provide adequate quantity or quality of data. MRAG Americas convened two panels of international experts familiar with monitoring programs to provide recommendations that can be applied to other fisheries on the development of comprehensive monitoring programs. These recommendations form eight categories of 'guiding principles' which offer specificity but remain general enough to allow monitoring program development on a fishery-by-fishery basis. The inter-related guiding principles work best if considered simultaneously, and will help managers, scientists, and stakeholders in a diversity of fisheries weigh the costs and benefits of various monitoring strategies. Monitoring programs are not static and may evolve or adapt as needs or circumstances change. Application of the guiding principles can help assure that monitoring programs evolve in an effective, efficient, and cost effective manner yet maintain a level of stability and confidence to allow for business plans to be developed, and can lead to more effective monitoring programs that support resource sustainability and other biological goals of management.



## SESSION 2

### Can industry data be used for monitoring rights-based fisheries, seafood traceability and/or fisheries certification?

Session lead: Lisa Borges | FISHFIX, Belgium  
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#### Session Description

The fishing industry is becoming increasingly proactive in the management and monitoring of its activity, resulting from the need to increase accountability pushed by NGOs but also by consumers. Industry run programs can be cheaper and more efficient, giving at the same time the industry empowerment to be more engaged and cooperative. The objective of this session is to give an overview of different industry monitoring programs that were used or started because of management, seafood traceability or fisheries certification needs.

#### Panelists

#### *EVOLUTION OF INDUSTRY OBSERVER PROGRAMME IN SUPPORT OF EVIDENCE BASED MANAGEMENT.*



Coull, K.A., Birnie, J.F.

Scottish Fishermen's Federation, Scotland.

In 2008, Scotland embarked upon a new way of managing its fisheries within the context of the EU management regime. Under new EU regulation, Member States were given the opportunity to manage days at sea for their own vessels under a block allocation of kilowatt-days. Scotland as part of the UK chose to manage its fisheries in this way and in doing so was able to begin creating incentives for fishermen to engage in extra conservation measures. A cooperative management body was formed, known as the Conservation Credits Steering Group (CCSG) made up of government, scientists, environmental NGOs and industry. This group, along with sub-groups dealing with matters such as technical measures for more selective fishing gear, cooperated on the management of the Scottish fleet. Measures introduced by the CCSG include a programme of seasonal and real-time closed areas which help to protect aggregations of cod, various selective gear measures including the “Orkney trawl”, larger square mesh panels and larger mesh cod ends. In return for adopting selective gear methods, fishermen were rewarded with increases in the days at sea allocation.

However, faced with decreasing resources it was clear that the Scottish Government was unable to provide the necessary fisheries observer support for verification of the benefits of any particular method or gear in order to provide both policy and science managers with the degree of confidence required to support these new management arrangements. This led to the creation of an observer programme managed by the Scottish Fishermen's Federation in conjunction with the Scottish Government, comprising of four sea-going observers and a data analyst who provided 500 days worth of fisheries data per year which helped to support the work of Marine Scotland Science as well as the CCSG. As the pressures created by the implementation of the Cod Recovery Plan continued to impact on particular sectors of the Scottish Industry, the need for rapid verification of Industry led measures to address selectivity and

discard reduction came to the fore. Through close cooperation between Industry, Marine Scotland and Scottish Fishermen's Federation it was possible to fast track the development and of Highly Selective Gears so that they could be approved as regulated gears. The Industry led Observer Programme continues to evolve and the next testing stage is to try and incorporate data collected from the various initiatives into stock assessments where many species classed as "data deficient" are subject to cuts base on precautionary principles.

### COMPARING TWO DUTCH SELF-SAMPLING PROGRAMMES FOR DISCARD MONITORING IN TERMS OF ESTABLISHING A SUCCESSFUL COLLABORATION BETWEEN FISHERMEN AND SCIENTISTS.



Nijman, R., Coers, A., Steenbergen, J., Quirijns, F.  
IMARES, Netherlands.

Substantial discard rates of undersized commercial fish, non-commercial fish and benthic species are observed in Dutch shrimp and bottom trawl fisheries in the North Sea. Growing awareness for this 'in the eyes of the general public' wasteful practice, has pressured fisheries managers to search for solutions for either reducing or completely eliminating discards. In order to proceed down this route in a meaningful way, and to support the debate, comprehensive (spatially as well as temporally) scientific data is needed, since discards rates tend to vary significantly among areas and seasons. In order to sample a sufficiently large and representative selection of the fleets in these two fisheries, self-sampling programmes have been implemented. Both programmes were initiated using a very similar operational setup but over time they have individually evolved into substantially differing projects in a number of aspects. Here we present a comparison of both projects and evaluate how we have experienced differences in terms of successfully implementing a programme in which fishermen independently of observers provide data and samples. The most important reasons for the need to differentiate between the two projects arises from the two projects being different in the inherent incentives provided to the collaborating fishermen. The bottom trawlers programme serves to meet EU data collection requirements, which is probably of little concrete meaning to the individually participating skipper. In this programme, however, fishers receive a financial incentive for each sample trip carried out. For the participating skippers in the shrimp fishery, the extension of fishing licences for the fleet, as well as possible future access to some Marine Protected Areas, is dependent on the collective choice of collaboration or non-collaboration. The choice of any individual skipper could thus potentially have dramatic consequences for the fleet as a whole. In the case of the shrimp programme the industry does not receive a financial incentive, but in fact provides half of the financial mean needed to run the programme.

Because much more is at stake for the shrimp fishers, they appear generally rather keen to follow developments of the project. This has made collaboration as well as multi-directional (relatively frequent) communication between scientists and fishermen much easier. In contrast, in the bottom trawler programme, engaging wholeheartedly in dialogue with each other has been more problematic. Hence, additional effort is required to come up with alternative ways of ensuring successful collaboration in this case. Recently, for instance a newsletter, written in non-scientific language was introduced to try to reach out to fishermen and establish an extra communication channel. By comparing these and other differences of the two programmes, and evaluating their success as well as how they have developed over time, we increasingly understand the necessary custom-made approaches to specific types of self-sampling programmes. These lessons learned hopefully will help future programmes to be optimally designed to successfully keeping fishers motivated and actively involved in the work carried out.



## AN OBSERVER PROGRAM FOR INDONESIAN LONGLINE FLEETS.

Reksodihardjo-Lilley, G.

Sustainable Fisheries Partnership, Indonesia.

An Observer Program for tuna longline fleets has been initiated by the Bali Benoa and Jakarta private fishing vessels and seafood processors. It is a voluntary program, and part of the Indonesian Tuna Fisheries Improvement Project (FIP), facilitated by the Sustainable Fisheries Partnership (SFP), an International NGO that helps seafood producers and buyers to promote the long-term security of their own supplies by improving fisheries conservation. The FIP is an alliance of stakeholders, catchers, processors, and retailers, and aims to resolve problems within a fishery, and improve specific aspects of a fishery. The Observer Program within this project has two main targets. The first is to train the crews of vessels to fill in logbooks, and second, to collect scientific data related to the fisheries for tuna and tuna-like species, as well as for by-catch, and accidental catch. The observers come from the Bali Benoa Research Institute for Tuna Fisheries, a government scientific observer program that researches fisheries in the Indian Ocean. The collaboration between the Research Institute and the company opens up the possibility of the industry supporting data collection with the data being collected by the Observer Program. This project has provided the Indonesian Government with a valuable learning experience, and is helping government personnel to better understand the conditions faced by the observers working aboard Indonesian vessels, as this is a high-risk job for them. Once the national regulations relating to the Observer Program are issued, it will become compulsory for companies to support the Program. As a member of the Indian Ocean Tuna Commission (IOTC), Indonesia has to comply with the IOTC resolution on the Regional Observer Program. The data collected by the observers will be collated and analyzed by the Research Institute as part of the stock assessment study. This paper will discuss the role of the industry in the management and monitoring of their fishing operations, the challenges of data collection and quality, and ways of scaling up the improvement efforts.



## ELECTRIC FISHING FOR FLATFISH IN THE NORTH SEA: PULSE TRAWLING

Rasenberg, M., Quirijns, F.

IMARES, Netherlands.

Electric Fishing is done by dragging wires on the sea bottom (the 'pulse fishing'), and allowing the fish to be startled from the bottom by electric stimulation. Many Dutch fishermen see pulse fishing as their future because of reduced fuel costs and good catches. At the same time, it is a heavily debated fishing method. Currently, 5% of the Dutch fleet (42 ships) uses the method on a temporary license. Whether they can continue using the method depends on politics but also on the availability of information and knowledge. To extend the amount of licenses for pulse fishing or to change the temporary license into a permanent one, more information was and is needed on the catch composition in pulse fishing. The Dutch government asked the fishing industry to provide these data. Therefore, in 2011 the fishing industry started a catch monitoring program together with research institute IMARES. 24 vessels participate in a self-sampling scheme and in addition ten independent observer trips were conducted. The fishermen were trained by IMARES to collect and sort samples from their catch. The participating fishermen take weekly at a fixed time a sample from the catch from one haul and sort this sample. The results are written down on the standard form that has been developed for this program and send it to IMARES. The data contains information on the volume of the total catch, the weight in kilograms in the sample of the quantities of plaice, sole, cod and other fish species (commercial and noncommercial), benthic species, stones, peat and shells. When registering fish species, a distinction is made in landing size and undersized fish. Halfway through the program, a quality check of the data was carried out. Based on the outcome, some changes were made in the program. Also, extra attention was given to fishermen that had problems filling in the forms in the correct way. The monitoring program will conclude in December 2012. The data are analysed and reported by scientists from IMARES. The data collected in the independent observer trips will be used as an extra control mechanism. Results of the monitoring program will be used in the discussion on whether

pulse fishing can continue. At the same time, the industry also wants to use the data for certification needs (MSC certification).



## *EFFECTS OF MSC FISHERIES CERTIFICATION ON THE IMPLEMENTATION OF OBSERVER PROGRAMS*

Gutiérrez N.L., Agnew D.

Marine Stewardship Council.

Observer programs are recognized world-wide as a critical tool in the sound management of fisheries. Many management agencies rely greatly on data collection by onboard scientific observers to feed into stock assessments, management plans and addressing bycatch and ecosystem impacts of fisheries. Observers can also play an important role in the monitoring, control and surveillance of fishing activities. The Marine Stewardship Council (MSC) is the world's leading certification and ecolabeling programme for sustainable seafood, with 132 fisheries currently certified and 141 more at different stages of the certification process. The MSC certifies fisheries as sustainable only if they score highly on three Principles which consider the health of the target stock, the impact of the fishery on the ecosystem, and the effectiveness of the management system. Fisheries meeting the standard are certified for five years and undergo annual surveillance audits. Those that meet the standard but are weak in certain areas can be certified if they commit to and demonstrate progress toward meeting agreed conditions on improvement. Thus, fisheries must demonstrate continued adherence to, and improvement in, a variety of aspects of sustainability to maintain their certification status. Fisheries observers programs can play a critical role in strengthening the sustainability of fisheries and in addressing those specific issues that could lead to improvements in fisheries entering the program. In particular, observers can provide the necessary information needed to address specific issues that could lead to improvements and consequent closing of conditions in already certified fisheries. An equally important aspect of MSC certification is the chain of custody to ensure that seafood carrying the MSC logo comes from the certified fishery and is not mislabeled catch from uncertified fisheries. Throughout the supply chain, use of the MSC ecolabel on fish products is only permitted where there has been independent verification that the product originated from an MSC certified fishery. In some fisheries, a critical step in the traceability of fish products starts onboard, where observers also play a critical role in verifying product origins. Thus, certification creates a tangible incentive for data collection and monitoring. However, these programs may be very costly and time consuming and the role and support of the fishing industry is critical to the efficient and sustained implementation of such programs. Here, we examine more than 140 fisheries currently in the programme and we highlight the effects of MSC certification in the implementation of fisheries observers programs. We also analyse and monitor scores for fisheries with full onboard scientific observer's coverage and we compare them with fisheries with weak or lack of coverage. Finally, we provide several examples where observers programs input has been critical in attaining and maintaining MSC certification.



## *THIS FISH: AN EXAMPLE OF INDUSTRY DESIGNED INNOVATION IN SEAFOOD TRACEABILITY*

Barney, A. Sutcliff, T.S., Tamm, E.N.

Ecotrust Canada, Canada.

Most people know very little about the seafood they eat. Products reaching markets are commonly mislabeled and/or from illegal or unsustainable fisheries. Meanwhile, responsible independent fisherman and fishing communities are declining in many regions that have been traditionally reliant on them. Additionally, when buying seafood products, consumers have limited ability to find out where their fish came from and make informed choices about what they are eating. This fish

is a three year old innovative business model, designed by Ecotrust Canada in collaboration with fishermen, fishing industry businesses and fishing communities, to raise the seafood veil, and enable seafood lovers to learn about their seafood and the fisheries that they come from. Thisfish has resulted in the successful creation of a seafood traceability system that includes fisheries distributed on both coasts of Canada, and in the Netherlands with growing global opportunities. The 'product' consists of a system to code seafood and track it through the value chain from ocean to plate. An online hub allows consumers to track their purchase, 'meet' their fisherman, and self-educate about their seafood choices. The system creates an unprecedented level of transparency across the seafood value chain, allowing fishermen and merchants to build trust with consumers, market products using authentic stories, increase brand loyalty, market share and producer benefits. How Thisfish Works: 1. The fisherman assigns a unique code to their catch and then they upload relevant fishing information to Thisfish.info. 2. As fish travels from ocean to plate, others in the supply chain can upload additional info about processing and handling. 3. Restaurateurs or retailers receive the fish and trace its origins. 4. Seafood consumers learn about their fish and connect to the fisherman who caught it, by tracing the code on Thisfish. Info in designing the system, we stay true to some core principles. ThisFish ensures traceability back to the harvesters; strives to be cost effective and accessible; adds real value to harvesters & seafood businesses; meets regulatory requirements; distributes costs and benefits fairly throughout supply chain; provides collaboration and transparency throughout the supply chain; supports sustainable fisheries; promotes consumer awareness and satisfies consumer demand; and creates a voluntary and consumer-focused system. Through the development of Thisfish, we have taken an approach that will create a traceability system which ensures an authentic, meaningful experience to consumers hungry for trusted information on the authenticity, quality and sustainability of their seafood; provides real-time market intelligence and branding advantages for every business in the seafood supply chain from fishermen to fishmongers; and is easy-to-use and low-cost, and is accessible to small and large operators.



IFOMC 2013  
Poster showroom

## SESSION 3a

### What are the future trends in fisheries monitoring programs?

Session lead: Howard McElderry |  
Archipelago Marine Research Ltd.,  
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#### Session Description

There is growing interest in the use of electronic monitoring (EM), often based on the notion that this may be a more cost effective and practical option. Over the past decade, EM has been tested across a wide variety of fisheries and, while the user base is expanding, examples of implemented EM programs are still very limited, suggesting that there are challenges in getting traction with this approach. The purpose of this session is to examine different test cases to better understand implementation issues and lessons learned.

#### Panelists



#### *FISHERIES MONITORING ROADMAP: A GUIDE TO EVALUATE, DESIGN AND IMPLEMENT AND EFFECTIVE MONITORING PROGRAM*

McTee, S. <sup>1</sup>, Stebbins, Sh. <sup>2</sup>, Lowman, D. <sup>3</sup>

<sup>1</sup> Environmental Defense Fund.

<sup>2</sup> Archipelago Marine Research Ltd., Canada.

<sup>3</sup> Natural Resources Consultant.

During the fall of 2011, a group of fishery experts convened in San Francisco, CA to discuss new and creative ways to support fisheries monitoring programs with the goal of improving stock assessment data, increasing fisheries value, and ensuring Annual Catch Limits are not exceeded. New technologies such as camera-based electronic monitoring (EM) were identified as potentially valuable tools to meet the challenges of increasing costs of monitoring. To date, the adoption of EM systems for use in U.S. fisheries is limited. A cursory review of EM pilot studies suggested that the limited use of EM tools was not resulting from a deficiency in the systems themselves, but by a recurring failure to clearly identify monitoring objectives and explore how EM data could be combined with, or complement monitoring data from other sources. The misperception that implementing EM only requires acquiring and deploying EM gear or that EM is a way to replace observers, also factor into to why EM has not been adopted for use in more fisheries.

The Fishery Monitoring Roadmap attempts to address some of these hurdles and advance efforts to find effective and efficient approaches to fisheries monitoring. Modifying a fishery monitoring program to include new sources of data or data collection tools can require regulatory revisions, changes in personnel, and the development of new infrastructure. Understanding the scope of change required and communicating those needs to relevant stakeholders, is critical to planning and successfully implementing a monitoring program. The Fishery Monitoring Roadmap is intended to assist managers and stakeholders in these processes. Composed of five complementary sections, the “Roadmap” includes: (1) a step-by-step process for evaluating, designing and implementing a fishery monitoring program; (2) a matrix to help identify data needs and an assessment of the ability of monitoring tools to meet those needs; (3) an outline of practical considerations and trade-offs of various monitoring tools; (4) a list of relevant references and resources; and (5) case studies to demonstrate how similar fisheries are implementing different monitoring tools.

As fishery managers and stakeholders look to new and emerging technologies to meet fishery monitoring and data needs, it is important to recognize that incorporating EM into a fishery monitoring program is a multi-step process that must be tailored to the specific needs of the fishery, fleet and often vessel. The Roadmap helps stakeholders understand differences between monitoring tools, and match tools with clearly identified management and monitoring goals, ultimately allowing for the optimization of fishery monitoring programs.



## MONITORING IN U.S. FISHERIES - 2013 AND BEYOND

Rilling, C.

NOAA/NMFS, USA.

In the United States, the National Marine Fisheries Service (NMFS) has traditionally relied on observers to collect data on commercial fishing and processing vessels because of their proven reliability and quality. Recent changes in fishery legislation requiring the implementation of annual catch limits to end overfishing and adoption of complex catch share programs have increased the burden on industry and managers alike to provide real time or near real time data at the lowest possible cost. Observer coverage requirements have produced high cost burdens that can be problematic for industry-funded programs and difficult for NMFS to fund given current fiscal constraints. Increasingly, the use of electronic monitoring (EM) technology (i.e. video monitoring) is perceived as a potential mechanism to augment and improve the efficiency of monitoring programs. However, despite numerous EM pilot projects over the years, to date NMFS has implemented EM in just three U.S. fisheries, exclusively for compliance monitoring purposes. Although efforts are ongoing, there are currently no operational video monitoring programs in NMFS-managed fisheries where data are used for science or management purposes. This presentation focuses on the apparent disparity in interest versus ability to implement EM, strengths and weaknesses of past and present EM projects, and the role of EM and observers in meeting future monitoring requirements.

The recent interest in the use of video monitoring to offset the cost of observer coverage stems in part from the proposed transition to industry-funded observer programs in several regions across the country and interest from NMFS, fishermen, and Congress to reduce monitoring costs. Video monitoring, also referred to as EM, has the potential to reduce observing costs while simultaneously maintaining compliance and delivering the necessary data, depending on the goals and objectives of the monitoring program. Video monitoring can potentially provide a cost-effective monitoring solution capable of collecting data for: (1) scientific purposes (species composition of catch and bycatch); (2) management (quota monitoring); and (3) compliance (enforcement).

Video monitoring can integrate the use of video cameras, gear sensors, and the GPS to provide data on fishing methods and gears, fishing locations and times, and catch and bycatch (including discards). The degree of integration depends on the specific objectives of the application. EM is not intended to be used exclusively as an alternative to human observers, in many cases electronic reporting (ER) and EM may be used to augment and improve monitoring programs. Thus there may be value in using these tools both as alternatives or in conjunction with human observers.

There have been numerous past and ongoing pilot projects in the U.S. exploring the potential to extract specific information from video for management and the agency learned a great deal from these projects that enabled the implementation of EM in existing programs. However, despite these projects operational issues remain, including the ability to accurately identify species and estimate weights of discarded fish, and the length of time required to obtain and review video and extract all requisite information.

Video monitoring is generally considered to have potential from a science and management perspective in fisheries where the catch is brought on board individually (gillnet, longline, and hook and line), and each specimen can be identified and total counts at varying taxonomic levels can be made. Video monitoring is less able to identify species (particularly protected species such as fish, birds, sea turtles and marine mammals) that may not be brought on board or that are not viewable in the frame. Video monitoring is also currently ineffective at determining weights aboard vessels that haul in large catches at once (such as trawl gear). However video monitoring may be effective at monitoring

compliance in full retention fisheries where species identifications and weights can be determined by dockside monitors.

Update: The NMFS recently issued a national policy encouraging the consideration of electronic monitoring and electronic reporting as part of a comprehensive Council-wide evaluation of more cost-effective means to collect fishery dependent data. The policy statement is posted on line at: <http://www.nmfs.noaa.gov/op/pds/documents/30/30-133.pdf>.



## *ELECTRONIC MONITORING - A TOOL TO PROVIDE FULL DOCUMENTATION IN A CATCH QUOTA MANAGEMENT SYSTEM*

Dalskov, J.

National Institute for Aquatic Resources, Denmark.

### **Introduction**

In the present Common Fisheries Policy (CFP) of the European Union a central measure is the limitation of catches in the form of total allowed catches (TAC). TAC is defined as the quantity that can be taken and landed from each stock each year and the European Council decides each year on TACs for the individual fish or shellfish stocks and the allocation of the TACs among Member States.

In 2008 the Danish Government suggested that the utilization of the marine resources in the EU in the revised CFP (adopted May 2013) should follow a result based approach with the requirement that the fisherman accounts for his total removal of fish from the resource rather than the landed catches

By introducing full accountability through catch quotas instead of landing quotas, the fisherman's incentive to optimize the value of his catch by discarding less valuable fish would be substituted by his incentive to use selective fishing methods to optimize the value of his total removals from the stocks. To achieve this objective the fisherman should receive increased quotas "catch quotas" to reflect that all fish is accounted for. At the same time he should be given the freedom of choice of method in conducting his fishery in order for him to make his own methods work for the best result. An incentive driven management system (Pasco et al. 2010) can have a positive effect on the will to live up to terms and conditions of a management system.

The present CFP with its quota and effort restrictions, high-grading ban and other restrictions contribute to a complex management system with a considerable incentive or obligation to discard catches. A catch quota management system with a fully documented fishery gives assurances that quotas can actually be administered with an absolute limit, so that catch limits becomes an exact expression of the set fishing mortality.

Whether a Catch Quota Management (CQM) system could work and whether a full documentation of the fisheries could be made by the use of electronic monitoring have been tested (Dalskov et al. 2009). The 2011 trial is similar to the 2010 trial (Dalskov et al. 2010) and is mainly focused in a concrete management and monitoring context where the purpose of the projects was to assess the catch-quota system's workability in a fisheries management environment and its potential to account for all catches, reduce discards, provide better scientific data and encourage fishermen to fish more selectively through catch-quotas using sensor and camera technology.

The Danish 2011 trial was a continuation of a trial conducted since 2008 and it has been coordinated with similar trials in the UK.

### **Methods**

Twenty-two vessels fishing in the North Sea and the Skagerrak participated in the 2011 trial. As in the previous trials the main focus has been on cod (*Gadus morhua*). Participating vessels were allocated an extra cod quota reflecting that the participating vessels counted all cod caught against their allocated quota including undersized fish that were

discarded according to EU regulations. Exceptions for the days-at-sea restrictions were given as provisions to reduce unaccounted catches are not relevant in CQM.

Archipelago Marine Research Ltd. (Archipelago), Victoria, BC, Canada who has developed and deployed video based remote electronic monitoring (REM) on a variety of gear and vessel types (McElderry, 2008) was chosen by DTU Aqua who decided to use this REM system for the scientific pilot project carried out in 2008-2009 (Dalskov et al. 2009). The same system was used during the 2010 CQM trial (Dalskov et al. 2011) and again in the 2011 trial.

The system comprises a GPS, hydraulic pressure transducer, a photoelectric drum rotation (winch) sensor and four television (CCTV) cameras providing an overhead view of the aft deck and closer views of the fish handling areas and discard chute areas for catch identification. Sensors and cameras were connected to a control box located in the wheelhouse. The control box consists of a computer that monitored sensor status and activated image recording. (McElderry, 2008).

The sensor and image data was stored on the REM hard disk drives. Danish AgriFish Agency staff collected the hard drives and subsequently all sensor data and selected video footage were interpreted using computer software developed by Archipelago Marine Research Ltd.

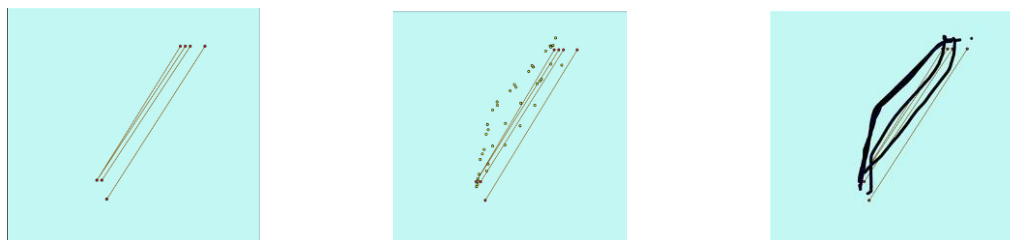
The purpose of sensor data interpretation was to determine the spatial and temporal parameters for start and end of each fishing trip and each fishing event. The key vessel activities including transit, gear setting, and gear retrieval were identified and compared with the logbook recordings.

The video footage was used to verify whether discards of cod had taken place without being recorded in the logbook. The REM systems have collected sensor data and images throughout the trial period and the vessels were at sea for approximately 80,000 hours, carried out approximately 1,114 fishing trips, and conducted approximately 9,800 fishing operations during the project period.

### Results/Discussion

One of the main objectives was to test whether REM system data could be used to verify the fisher's logbook recordings. By analysing the sensor data it was possible to compare accuracy of the date, time and position of each fishing event with the information the fisher has recorded in his electronic logbook (E-log) and with the sensor data collected by the REM system. When using the REM system's GPS data in combination with the hydraulic pressure data it was possible to determine the exact date, time and position for shooting the gear and the retrieving of gear. We compared the difference in time for shooting the gear recorded in the fisher's logbook with the time determined from the REM system data for 7,842 fishing events. In 66 % of the events the differences are less than 15 minutes which can be regarded as acceptable. There is still 34% where the difference is more than 15 min. and it leaves, however, room for improvement where the fishers have to be more precise and focused on their recordings and more precise definition for when shooting and hauling position for Danish seiners has to be made.

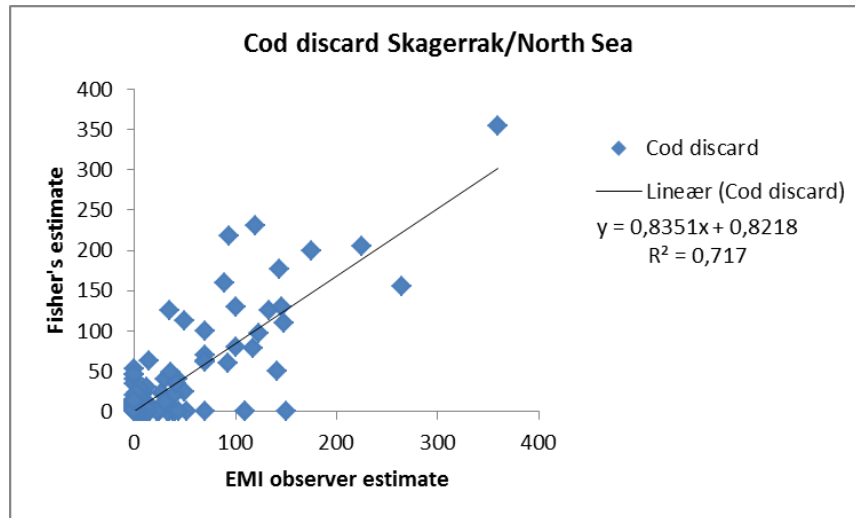
A comparison of the precision of the REM system data compared to the mandatory Vessel Monitoring Systems (VMS) data and logbook recordings on fishing positions have been made (Figure 1).



**Figure 1.** The picture (left) show the shooting and hauling position recorded in the logbook. The picture (middle) VMS positions (1 per hour) where the vessel speed is more than 3 knots are included and at the picture (right) the bold lines shown the REM positions as well.

The vessels in the trial had to retain and land all fish above the minimum landing size according to the EU regulation. For most species the price per kg increases with fish size and vessels may benefit from only retaining large fish and discard small ones. This type of illegal discard is known as “high grading”.

In general there was a good consistency between the fishermen recording and the image data. Though improvement can be made especially if the area around the discard chute could be adjusted with regard to optimal video footage (Figure 2).



**Figure 2.** Relationship between the estimates from observers and fishers of discard of cod from CQM vessels in 2011,  $n = 727$ . The slope of the linear equation is 0.835 which being close to 1 indicates that there was a good coherency between the fisher’s and the observer’s estimate of discard. The fisher’s estimates of volume of discard were in general smaller than the observer’s.

The trial has also shown that as all catches have to be counted against the quota fishers have reduced their discards significantly. The skippers of the trial vessels are avoiding fishing grounds with small cod and “highgrading” is eliminated. Table 1 show discard % of total cod catches by trial vessels compared to similar fishing vessels (reference fleet) for trawlers and gill netter for the North Sea and the Skagerrak.

Fishing fleet	2010		2011		2012	
	Other vessels	Trial vessels	Other vessels	Trial vessels	Other vessels	Trial vessels
<b>North Sea trawlers (Mesh size =&gt;120 mm)</b>	9.6%	0.4%	13.7%	1.5%	22.9%	0.9%
<b>Skagerrak trawlers (Mesh size =&gt;90 mm)</b>	41.7%	1.2%	55.7%	1.5%	40.1%	2.5%
<b>North Sea gill netters</b>		0.0%	2.2%	0.0%	3.6%	0.0%
<b>Skagerrak gill netters</b>	4.1%	0.0%	4.0%	9.0%	2.3%	0.2%

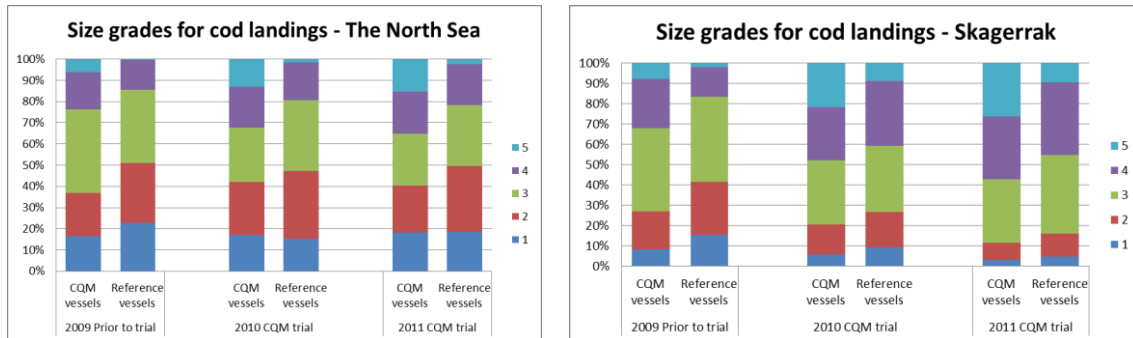
**Table 1.** Discard % of total cod catches by trial vessels compared to similar fishing vessels (reference fleet) for trawlers and gill netter for the North Sea and the Skagerrak.

The size grade composition for cod catches from the trial vessels was compared with the reference fleet by comparing their respective landing patterns. The proportion of the smaller size grade (size grade 4 and 5) cod can be an indication of high-grading (discarding with the aim of increasing the value of the landings).

For the vessels fishing with  $\geq 120$ mm mesh size in the North Sea (fig. 3) the trial vessels had 5 % size grade 5 cod (smallest size grade) in their landings in 2009 (before joining the trial scheme) which rose to around 12 and 13 % in 2010 and 2011 respectively, both trial years. The reference fleet showed only a weak increase (1-2 %) in landings of



size grade 5 cod during the same time span. For the size grade 4 only a slight increase in the landings is seen for both groups of vessels after the onset of the trial.



North Sea, mesh size => 120 mm

Skagerrak, mesh size => 120 mm

**Figure 3.** Size distribution of cod landings from the trial vessels and reference vessels. All vessels have been fishing with trawl or seine.

For the vessels fishing with  $\geq 120$ mm mesh size in Skagerrak (fig. 3) the trial vessels had approx. 7 % size grade 5 cod in their landings in 2009 (before joining the trial scheme) which after the CQM trial began rose to  $>20$  % and 27 % in 2010 and 2011 respectively. The reference fleet increased its landings of size grade 5 cod (from 1-2 % to 8-10 %) during the same time period. For the size grade 4 a small increase was seen for the trial vessels from 25 % (2009) to 30 % (2011) while the reference fleet during this period more than doubled the proportion of size grade 4 in the landings from 15 % (2009) to 35 % (2011).

The different stakeholders in CQM will have different needs regarding data requirement and handling. From a control perspective (e.g. with respect to a discard ban) documentation by cameras will be sufficient while the data requirement for use in science would need recordings of several other variables.

During the trials a number of challenges arose, some of a more technical nature and others of a more human nature. The technical challenges could often be solved, such as change of the control box, cameras or repair of the cabling. Training of the crews and the skippers was a continual task to be done. Even though the fishers are used to report in an electronic logbook, it was realized that guidance on how to register information in the logbook correctly should be done repeatedly. Among the most common flaws is the lack of haul by haul registrations of discards. Other flaws seem to be the result of negligence, e.g. cleaning camera lenses or the correct display of discards in front of the camera reducing the accuracy of the monitored discards.

Implementation of a discard ban and the use of REM system would ease the video footage review process significantly as it easily can be controlled whether discarding has taken place.

From the Danish experience it is recommended to maintain a variety of sanctions that can both deter fishers from committing new offences and remain proportional to the infringements. This entails the use of fines in less serious cases and the use of harsher measures such as the withdrawal of quotas and fishing permits in more serious cases of infringement of fishing rules.

The main outcome of the trials is that CQM with a full documentation is a feasible management measure to ensure that quotas can actually be administered with an absolute limit, so that catch limits becomes an exact expression of the set fishing mortality. The REM system can be applied on almost all types of vessels and the systems have proven its technical reliability. Furthermore, in general, industry has accepted having REM aboard their vessels. There has been no negative feedback on the issue of having cameras recording the vessel's working areas. Most of the fishers are of the opinion that it is important to show what they are doing and what they are catching.

### Acknowledgement

I would like to thank my co-workers on the project, my colleague Hans Jacob Olesen at DTU Aqua and Søren Palle Jensen and Flemming Schultz at the Danish AgriFish Agency. I would also like to thank all skippers and crews on the participating fishing vessels.

## COMPARING THE COSTS OF ONBOARD OBSERVERS AND REMOTE ELECTRONIC MONITORING (REM): A SCOTTISH CASE STUDY



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### Introduction

Fisheries monitoring, to date, has been extremely limited even in the most established fisheries monitoring schemes. This is largely due to the difficulties in coordinating for an observer to go onboard a fishing vessel at late notice, in addition to the extremely high costs of sending observers to sea for any length of time. As such, there is an ever increasing demand from stakeholders to provide more quantitative and qualitative fishery data for stock assessment. In addition, European nations are now facing the implications of a discard ban, which will require additional monitoring to ensure compliance, and requires suitable knowledge to address the issues arising from such legislation. One of the biggest issues regarding observer programmes is the insufficient funding available compared to the expected costs<sup>1</sup>. With costs for observers remaining high, and therefore limited, alternatives to on-board observers have been explored in recent years. One option has been trialed in Scotland in the form of Remote Electronic Monitoring (REM).

The REM system provided by Archipelago Marine Research Ltd has a standard setup of up to 8 cameras placed around the vessel, a GPS receiver, hydraulic pressure sensor, winch rotation sensor, system control box and user interface. Whilst the vessel is at sea the cameras and sensors are recording continuously, providing data related to fishing and catch sorting activity. This data can then be analysed back on shore at a later date thus freeing up observer time and costs. There are a limited number of studies available suggesting that REM can be provided at a lower cost than on-board observers. McElderry and Turriss<sup>2</sup> state that REM can be provided at a quarter of the daily cost of observers. Ames et al<sup>3</sup> suggest that in the Alaskan longline fishery REM systems could operate between a third and a half of the cost of observer programmes. Meanwhile in Denmark it has been estimated that an REM system could offer much the same data as the observer scheme at as little as one tenth of the cost<sup>4</sup>.

The aim of this study, therefore, is to examine the costs involved in both the Scottish onboard observer scheme and the Scottish REM scheme. The costs of one onboard observer will be compared against one REM analyst using data from one REM equipped vessel over a period of ten years. It will then build in additional observers, REM vessels and analysts to examine how the costs change.

### Methods

Costs from the components of each method were obtained from purchase orders, salary information or current market value. In cases where exact information was not available, costs were estimated based on the current scheme-for

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<sup>1</sup>WWF report. 2006. Observer Programmes: Best practice funding options and North Sea case study. A report to WWF by Marine Resources Assessment Group. 88p.

<sup>2</sup> McElderry, H., and Turriss, B. 2008. Evaluation of monitoring and reporting needs for groundfish sectors in New England. Pacific Fisheries Management Incorporated and Archipelago Marine Research Ltd Report. 68p

<sup>3</sup> Ames, R.T., Williams, G.H., and Fitzgerald, S.M. 2005. Using digital video monitoring systems in fisheries: Application for monitoring compliance of seabird avoidance devices and seabird mortality in Pacific halibut longline fisheries. U.S. Dep. Commer., NOAA Technical Memorandum. NMFS-AFSC-152,93p.

<sup>4</sup> Kindt-Larsen, L., Kirkegaard, E., and Dalskov, J. 2011. Fully documented fishery: a tool to support a catch quota management system. ICES Journal of Marine Science. 68:1606-1610.

example maintenance costs were calculated as an average of costs across the current REM fleet. Costs were projected annually over a ten year period using an inflation rate of five percent.

**Results/Discussion**

Results were plotted for five different scenarios.

Table 1 shows the number of observers compared to the number of REM vessels and analysts in each scenario tested.

REM costs are shown to be very high in the first year due to high equipment and installation costs. Following the first year the price drops considerably and then continues to rise at a steady rate reflecting inflation. In year six there is a small peak due to replacement equipment. The observer costs meanwhile increase steadily from year one reflecting rising costs due to inflation.

On-board Observers	REM	
Observers	REM Vessels	Analysts
1	1	1
4	21	2
4	130	4
4	400	11
116	400	11

**Table 1.** Number of observers compared to the number of REM vessels

When one observer is compared to one REM vessel and analyst, the observer costs around a third more than REM in the first year, and approximately twice as much in the following years (Figure 1). Observer costs are cumulatively higher than those for REM throughout the ten years.

When the number of observers was raised to 4, and the number of REM vessels and analysts raised to

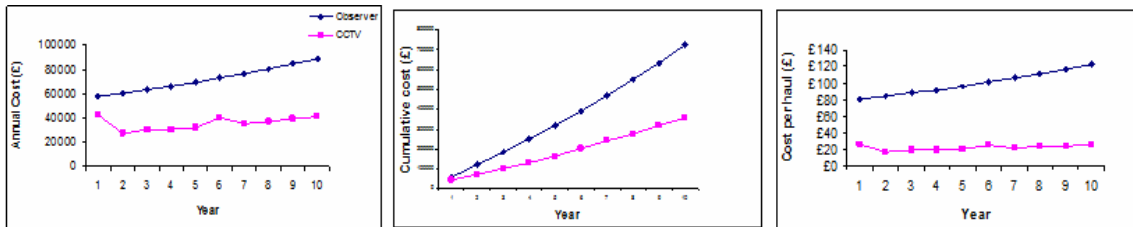


Figure 1. shows the annual costs, cumulative costs and cost per haul over ten years for one observer compared against one REM vessel and one analyst.

21 and 2 respectively, as a simulation of the current Scottish setup, the initial costs in year one are higher for REM, but this is reversed in year 2, when it cumulatively continues to be cheaper than an observer. If the number of REM vessels and analysts were increased to 130 (representing the whitefish fleet) and 4 respectively, the costs for REM are now much higher. The costs per haul however remains cheaper after year one, as more hauls are analyzed for the price. When the REM vessels are increased further, to 400, representing the entire Scottish fleet, and analyst number increases to 11, this pattern is repeated, only with a much higher difference. Here, by year 3 the cost per haul is equal for both methods. In a purely hypothetical scenario, the assumption is made to get an equivalent 20% of hauls covered using 116 observers. Here, the cost of observers is much higher than the cost of REM for the entire ten years. Costs per haul are similar from year 3 onwards.

Scenario	Annual Cost	Cumulative Cost	Cost per Haul
A	REM < Observer	REM < Observer	REM < Observer
B	REM < Observer after Year 1	REM < Observer after Year 1	REM < Observer after Year 1
C	REM > Observer	REM > Observer	REM < Observer after Year 1
D	REM > Observer	REM > Observer	REM < Observer after Year 1
E	REM < Observer	REM < Observer	REM = Observer after Year 2

**Table 2.** Summarising the costs for each method across 5 different scenarios

The cumulative costs for REM are heavily influenced by the high first year costs. Although the annual costs give estimation for both methods, observer and REM setups are not directly comparable in terms of data quantity, and so the cost per haul gives an indication of which method provides better value for money. For example, in scenario C, although annual costs are higher for REM, the cost per haul is lower than that of observers, showing that although it is more expensive, the rate of data collection is much higher.

Comparing the two methods at a ratio of one to one shows the observer to be approximately double the cost of REM over the ten year period. However, this changes with the addition of further REM vessels, as the equipment and installation fees hold much of the expense. In order to provide a similar level of coverage, however, a considerably higher number of observers would be required, as seen in the final plot which in turn increases the costs of the observer very substantially.

Whilst REM may have lower costs acting as an incentive to its use<sup>5</sup> it is important to consider that regardless of cost, each method has its own merits and drawbacks, and therefore they are difficult to compare like for like, particularly in such a small scale study. An observer takes a sample two boxes from every haul whilst he's onboard, but for a limited number of trips each year. Meanwhile a REM analyst counts the entire haul, but only for 20% of hauls therefore allowing greater trip coverage. Whilst both methods can collect counts and length measurements, only an observer has the ability to collect additional data such as age, sex or maturity. It is therefore possible that neither one is more appropriate for use than the other, but rather a combination of the two should be used to achieve the best possible data at the most cost effective price. REM can be seen as an investment to ensure suitable monitoring levels over a number of years, and observers can collect samples of the additional data that REM cannot provide, whilst also providing an important link between the industry and science. Whilst labour costs will only ever increase with the cost of inflation, REM provides the power to maximise the labour time spent, and in addition the equipment required is likely to decrease over time with technological advancement<sup>6</sup>

<sup>5</sup>Ames, R.T., Leaman, B.M., and Ames, K.L. 2007. Evaluation of video technology for monitoring of multispecies longline catches. *North American Journal of Fisheries Management*. 27: 955-964.

<sup>6</sup>McElderry, H., Illingworth, J., McCullough, D., and Schrader, J. 2005. Electronic monitoring of the Cape Cod haddock fishery in the United States - a pilot study. Unpublished report for the Cape Code Commercial Hook Fishermen's Association by Archipelago Marine Research Ltd., Victoria BC Canada. 37p.

## AN ELECTRONIC MONITORING PROJECT IN THE NORTHEASTERN UNITED STATES

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### **Introduction**

The National Marine Fisheries Service's (NMFS) Fisheries Sampling Branch (FSB) of the Northeast Fisheries Science Center (NEFSC) is conducting a pilot study in conjunction with Archipelago Marine Research Ltd., to investigate the utility of Electronic Monitoring (EM) technology as a monitoring tool in the Northeast Multispecies Fishery. The NMFS is researching acceptable monitoring alternatives to explore the most advanced technology available to meet coverage levels and industry needs (e.g., real time data to manage catch allocation). A secondary goal of the project is to build local knowledge and infrastructure within NMFS and local providers. To facilitate this goal a number of informative outreach meetings and discussions with stakeholders have taken place. Furthermore, NMFS staff have been trained in equipment installation and maintenance, data retrievals, data review, and data management.

Monitoring is expected to become an industry responsibility in 2014 and EM has been proposed as a monitoring option to traditional data gathering and catch monitoring methods. If EM is determined by NMFS to be effective at groundfish catch monitoring, it may be used in place of an At-Sea Monitor. The traditional observer program would continue to deploy on a portion of groundfish trips if EM were approved. The study began in May 2010 with ten participating vessels in the bottom otter trawl, gillnet, and longline fisheries. A total of 14 vessels have participated in the study since 2010. At this stage of the project, lessons learned are being applied to EM reporting requirements within a dynamic management structure.

### **Methods**

The first phase (May 2010 to August 2011) of the pilot study concentrated on five major objectives: 1) installation of EM systems on up to 13 vessels, 2) conduct outreach meetings with interested fishermen, sector managers, and other interested parties, 3) build local capacity in providing field (equipment) services by selecting and training a local subcontractor, 4) train FSB staff in EM data management, interpretation, and quality assessment and 5) interpret EM data collected, including determination of fishing events and counting and identifying all catch.

The second phase (September 2011 to May 2012) investigated the ability of EM to overcome the system limitations identified during the first phase through a series of dedicated experiments. Four major areas of concern were identified and explored during this phase. The experiments focused on effectively identifying regulated species, comparing known to estimated weights, obtaining accurate length estimates, and exploring the use of volumetric measurements to estimate weights.

During the third and final phase of the study, project staff members are working to test two approaches which could be applied to an operational EM program. The first approach is the audit approach which requires the captain and crew to estimate catch on a haul basis. During the audit approach the captain and crew track the discarded regulated species using both a count and an estimated weight for each species and record the estimates using a log provided by project staff. The second approach is the full retention approach where vessel crews are required to land all catch with some exceptions (protected species, etc.). During the full retention approach the captain and crew are required to conform to specifications laid out by project staff and record haul level information (position and time) as well as notes justifying any departure from the retention specifications.

During each phase of the project, staff members work toward improving species identification, weight estimates, and equipment reliability. To support this effort, new digital cameras were installed at the start of phase III, new methods to aid in species identification and advancements in estimating length were explored and protocols were refined, and all equipment issues were addressed and documented.

### **Results/Discussion**

Study results demonstrated there are issues with the accuracy and reliability of species identification and the monitoring of discarded fish weights; both necessary components for quota allocation monitoring. There are inherent challenges with the EM system, including: equipment maintenance and vessel infrastructure requirements, identification of catch to the species level, data integrity, and enforcement of program requirements. However, FSB continues to explore the application of EM technology for additional monitoring objectives. While these challenges restrict the utility of EM, they do not completely preclude the use of this tool as an effective monitoring instrument in fisheries management.

Through this experience, FSB has acquired knowledge on the strengths and weaknesses of EM, effective and non-effective operational approaches, management systems that would benefit from EM, and advantageous system requirements. For example, EM technology may be successful in certain management strategies such as full retention fisheries or may be a valuable resource if used in combination with self-reporting as an audit or validation tool. With a complete understanding of the technology, fisheries managers can tailor EM to meet fishery needs and determine the most appropriate application for EM in fisheries monitoring.

### *A PILOT STUDY*

### *OF AN ELECTRONIC MONITORING SYSTEM ON TROPICAL TUNA PURSE SEINE FISHERY*

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1. Institut de recherche pour le développement (IRD), France.
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4. Archipelago Marine Research Ltd, Canada.
5. International Sustainable Seafood Foundation (ISSF), USA.

The catch of non-target species (bycatch) and associated discards are becoming a concern in the fishery management community as bycatch may contribute to overfishing, endanger vulnerable non-target species and may alter the structure and functioning of marine ecosystems.

Observer programs are an important tool to monitor fisheries, and are considered the most reliable source of information and, in the case of the bycatch and discard monitoring, the only source of information.

One challenge in implementing observer programs is the difficulty of ensuring an adequate observer statistical coverage, which may hamper the usefulness of observer data for management purpose. These constraints make it necessary to find alternative methods that can be, when combined with current observer programs, to improve data collection coverage with acceptable costs.

In recent years, Electronic Monitoring (EM) has become a viable alternative to observers in many fisheries and has been identified as a possible complementary method to use in tropical tuna purse seine fleet.

We carried out three studies from December 2011 to August 2012 to examine the potential application of EM in the tuna purse seine fishery in order to collect unbiased and precise effort, catch and bycatch data. EM and observers were deployed simultaneously on three purse seine fishing vessels (Indian, Atlantic, and Pacific Oceans), covering 8 trips (~250 seadays) with over 150 fishing events. Results indicate that set-type (free school versus fishing aggregating device) and total sets can be reliably determined using EM. Additionally, results show that EM and observer estimates of retained total tuna catch are not different; however, estimates of bycatch are more variable and require further refinement. Overall, bycatch species were underestimated by EM.

Sometimes EM-based catch assessment was limited by the technology itself (quality of imagery). But the most influential factor in the difference between EM-based and observer estimates was the complex and unstandardized catch handling on the vessel. Given the limited number of cameras on the EM system, and high number of points for

catch handling, the monitoring of bycatch with EM will be difficult until either more cameras are installed, or fewer catch handling point are used.

Based on this research, EM is emerging as a viable tool for monitoring effort, set-type, tuna catch, and some types of bycatch within the tropical tuna purse seine fishery. Operational aspects that need to be considered for an EM program to be implemented include defining monitoring objectives, standardising installation and onboard catch handling methodology, and developing data and field service provision frameworks to support the program.

## *EVALUATION OF ELECTRONIC MONITORING AS A TOOL TO QUANTIFY CATCH IN A MULTISPECIES REEF FISH FISHERY*

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<sup>2</sup> South Atlantic Fishery Management Council U.S.A.

<sup>3</sup> Archipelago Marine Research, Ltd., Canada.

### **Introduction**

The United States South Atlantic snapper grouper commercial fishery includes at least 61 species caught primarily with vertically fished hook-and-line (bandit) gear deployed from small vessels<sup>1</sup>. Discards are common in the fishery and may be impacting current management strategies<sup>2</sup>. Self-reported logbooks are the primary data source for the fishery. Observers have occasionally been used to document catch in this fishery, but electronic monitoring (EM) may provide an alternative and less costly method to perform complete catch accounting.

Video-based EM is a technology that has been piloted or recently implemented in over 25 studies spanning diverse geographies, fisheries, fishing vessels, gears and monitoring issues<sup>3</sup>. Electronic monitoring is typically characterized as an onboard system that collects fisheries data using a series of sensors (drum, hydraulic pressure, GPS) and video cameras installed throughout a fishing vessel along with a user interface in the wheelhouse. Data is typically collected for the duration of each trip, stored on external computer hard drives and removed post-trip for processing using standardized technique. The use of an EM system in fisheries varies depending upon the desired monitoring objective(s). The principle objective of this research effort was to compare EM based catch counts to catch counts recorded by an at-sea observer over the course of five trips on four different vessels in this fishery.

### **Methods**

Four fishing vessels each agreed to host both an observer and an EM system for a total of five trips (26 sea days) for this study. Each vessel was equipped with three to four bandit reels, each operated independently by one or more crew members. Standard terminal tackle (2 hooks per reel) was used by all vessels<sup>2</sup>. Fishing occurred in the U.S. Atlantic Ocean off the coasts of North Carolina, South Carolina and Georgia from June 14 to Sept 24, 2010.

The EM systems used for this project were custom manufactured by Archipelago Marine Research, Ltd. (Archipelago) in Victoria, British Columbia. System installation on fishing vessels consisted of three to four cameras (typically one camera for each bandit reel), a rotational drum sensor, a global positioning system (GPS) and a control box in the wheelhouse. Image data recording was set to record only when drum sensor rotations exceeded a threshold (one rotation) and continued recording for ten minutes after sensor activity dropped below the threshold indicating fishing activity had stopped.

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<sup>1</sup> SAFMC (South Atlantic Fishery Management Council). 2006. Snapper grouper Amendment 13C. SAFMC, Charleston, South Carolina.

<sup>2</sup> Rudershausen, P. J., J. A. Buckel, and E. H. Williams. 2007. Discard composition and release fate in the snapper and grouper commercial hook-and-line fishery in North Carolina, USA. *Fisheries Management and Ecology* 14:103-113.

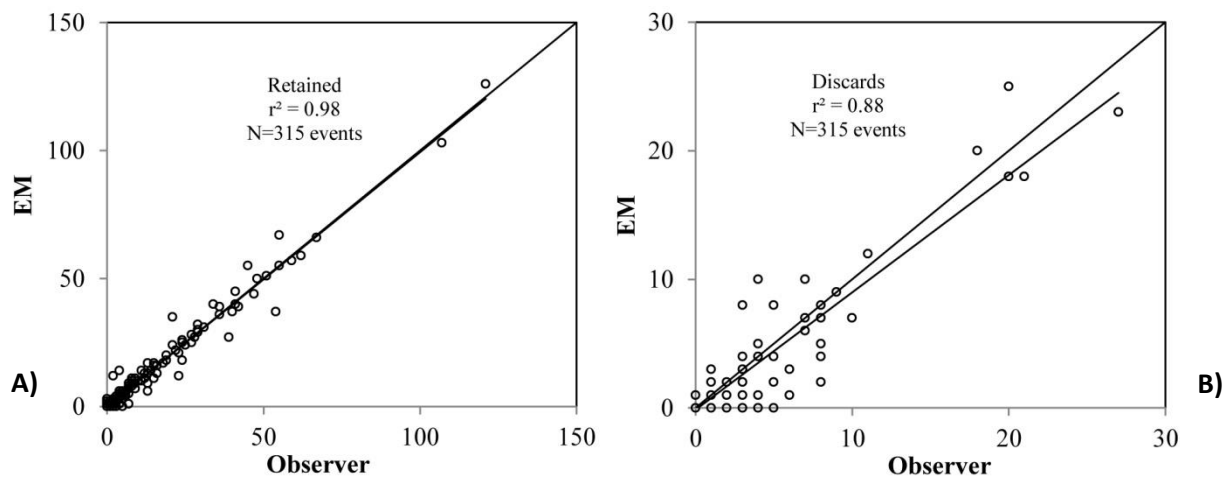
<sup>3</sup> Ames, R. T., B. M. Leaman, and K. L. Ames. 2007. Evaluation of video technology for monitoring of multispecies longline catches. *North American Journal of Fisheries Management*, 27:955-964.

Observer data provides a similar level of data collection against which EM data can be compared. The same observer accompanied all trips and recorded data at the hook level (i.e., time of capture) for each bandit reel and camera combination observed. When hooks were retrieved from the water, the observer collected the following data: time of retrieval, species, disposition, and other general comments. Each series of hook-level observations for an individual bandit reel was recorded as a separate fishing event. This step was necessary in order to match observer data with EM video.

Archipelago EM viewers used the observer data as a guide to define fishing events for imagery review. A custom software package was used that provided synchronized playback of all camera imagery and a data entry form for recording catch observations in a sequential manner. Viewing for catch documentation was done only for the cameras that had catch documented by the observer for the comparison.

**Results/Discussion**

A total of 2,729 individual catch items were counted by the observer over the course of five trips and 315 fishing events. Discards comprised 14% of the observer’s catch record and occurred in 103 of the 315 fishing events. Retained catch occurred in 214 events. The EM viewer recorded 93% of the observer’s catch items. Agreement between the EM reviewer and the observer was high for retained catch items, but lower for discarded catch items (Figure1). Oversight of visible catch items by the EM viewer and insufficient catch handling practices by fishermen to facilitate video review appear to be responsible for most of the count differences.



**Figure 1.** Comparison of EM to observer catch count for (A) all retained and (B) all discarded catch items.

The goal of this pilot study was to test EM as a proof of concept for this fishery and determine how well the technology and standardized EM review procedures might work when applied to this fishery. Results of this pilot study indicate that EM has the potential to augment existing data collection programs in this and similar fisheries. Further efforts should focus on improving EM based discard catch counts and developing (with industry involvement) better catch handling practices for use by fishermen to facilitate EM video review. While standardized catch handling practices could likely be implemented through the use of incentives or disincentives to achieve high levels of data quality – these factors are very difficult to implement in a short-term pilot studies and we had no authority to implement those here. Future EM pilot studies should explore creative incentive programs and clearly communicate to the fishing industry the benefits and advantages for collecting such high quality data.



## SESSION 3b

### What are the future trends in fisheries monitoring programs?

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E-mail: dennis.hansford@noaa.gov

#### Session Description

There is growing interest in the use of electronic monitoring (EM), i.e., video monitoring, often based on the notion that this may be a more cost effective and practical option. However, EM can include other electronic technologies such as E-logbooks, handheld devices for data entry, and data collection software. The purpose of this session is to examine other electronic technologies used to collect and analyze observer data.

#### Panelists

#### ON BOARD FISHERIES OBSERVER PROGRAM: "LOGBOOK": TOWARDS THE ECOSYSTEM-BASED APPROACH IN PERÚ

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#### Introduction

The Peruvian marine ecosystem is characterized by having a very intense coastal upwelling system, high productivity and high variability, which favors the development of large volumes of fishery resources<sup>1,2,3</sup> In Peru, fishing is one of the most important economic activities and anchovy fishery supports over 90% of the GDP for fisheries.

Current trends in fishery recommend management within the comprehensiveness of its ecosystem or the so called "ecosystem management"<sup>4</sup>, considering that fishery not only impacts on the target population, but also on other components of the ecosystem. In this sense, IMARPE created the Onboard Fisheries Observer Program Logbook which dates back to the recommendations of expert panels on anchovy in the seventies<sup>5,6,7</sup>. The Program initially started to deal with problems related only to the anchovy, but now it has been extended to other components of the ecosystem. In this sense, this Program allows the collection of information to strengthen investigations on major pelagic resources, top predators, the environment and others, making it an observational platform for the ecosystem approach.

<sup>1</sup> AGÜERO M. 2007. Capacidad de pesca y manejo pesquero en América y el Caribe. FAO Documento Técnico de Pesca. N° 461. Roma. 403 pp.

<sup>2</sup> NIXON, S. THOMAS, A. 2001. On the size of the Peru upwelling ecosystem. Deep-Sea Research I 48, 2521 – 2528.

<sup>3</sup> BAKUN A, WEEKS S. 2008. The marine ecosystem off Peru: What are the secrets of its fishery productivity and what might its future hold? Progress in Oceanography 79: 290 – 299.

<sup>4</sup> FAO 2008. The state of world fisheries and aquaculture. FAO Fisheries and Aquaculture Department, Rome, 196 pp.

<sup>5</sup> IMARPE. 1970. Report of the panel of experts on population dynamics of Peruvian anchoveta. Bol. Inst. Mar Perú-Callao 2(6): 234-372.

<sup>6</sup> IMARPE. 1972. Report of the Second Session of the Panel of Experts on population dynamics of Peruvian anchoveta. Bol. Inst. Mar Perú-Callao 2(7): 373-458.

<sup>7</sup> IMARPE. 1973. Report of the Third Session of the Panel of Experts on population dynamics of Peruvian anchoveta. Bol. Inst. Mar Perú-Callao 2(9): 525-599.

### Methodology

IMARPE has 25 scientific observers randomly distributed along the Peruvian coast; the number of observers has varied over time and has relied mainly on economic allocation. Their level of training is mostly professional: Fishery Biologists and Engineers, and some Fishery Technicians.

Observers randomly operate aboard industrial and artisanal vessels and remains aboard for the number of working days assigned per month. Coordination for boarding is carried out before the start of the fishing season between IMARPE, the Functional Area of Population Dynamics and Pelagic Resources Assessment, and the fishing company that owns the vessel.

The observation unit is the "fishing trip" and during each trip the observer scores on a record file called "logbook", which collects information on the vessel, fishing effort, catch, biological aspects, observation on top predators, among others (Table 1).

Vessel Information	Trip Information	About the set
Vessel name	Departure date	Start date
Vessel license	Arrival date	Finishing date
Fishing Company Name	Departure Port	Initial situation
Holding capacity (m <sup>3</sup> )	Arrival Port	Finishing situation
Type of cooling	Landing port	Detection means
Manufacture year	Time spent	Features of the shoal (school)
Dimensions	Search time	Held catch (t)
Building material	Number of sets	Discarded catch (t)
Engine features	Held catch (t)	Total catch (t)
Net features	Discarded catch(t)	Species composition
Acoustic equipment	Received catch (t)	Sizes by species
Number of crew	Total catch (t)	Bird interactions
	Landing (t)	Mammal interactions
	Birdwatching	Turtle interactions
	Mammal watching	SeaSurface Temperature (SST)
	Turtle watching	

**Table 1.** Collected data aboard purse seine vessels fishing logbook on the fishing trip.

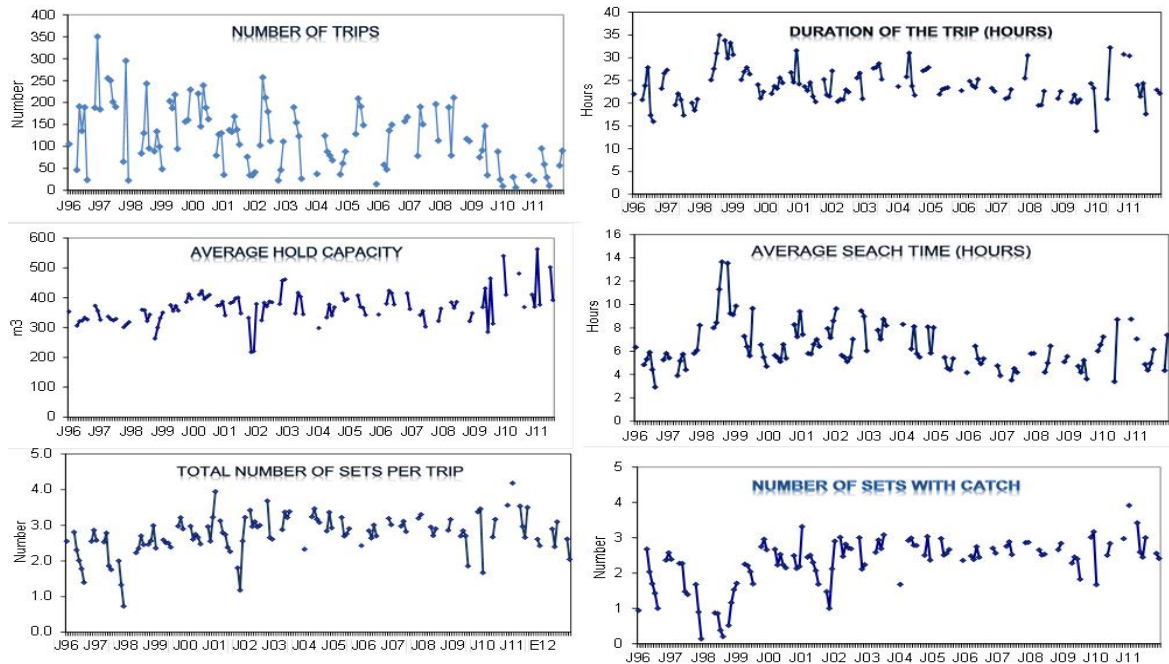
The frequency of observations is daily, and the fishing logbooks are referred to the Functional Area of Population Dynamics and Pelagic Assessment (IMARPE), where it is verified, digitized and stored in the database of the institution called IMARSIS. Also the Program includes an operations manual<sup>8</sup>

### Results/Discussion

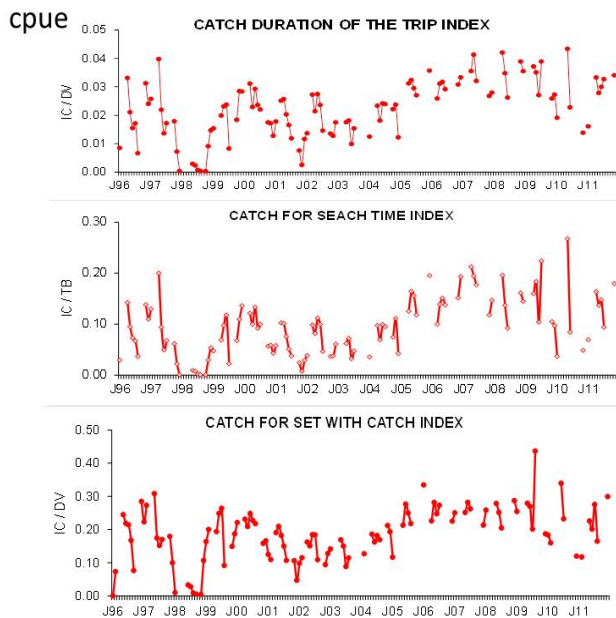
The results clearly show how an onboard observer program can help in monitoring a fishery, improving data collection, currently including the observation of other ecosystem components such as discards and bycatch, biology and fishery of other pelagic species, fishing effort applied to species other than anchovy; bird, mammal and turtle watching, collection of water samples, usage of zooplankton nets, photographing of acoustic records, among others. All this makes the program fall within the guidelines for an ecosystem management. Among the most important are: *Effective fishing effort*

<sup>8</sup> BOUCHON M, ÑIQUEÑ M, ARIAS M, BELLO R. 1997. Manual de Operaciones del Proyecto Bitácoras de Pesca. Inf. Prog. Inst. Mar Perú-Callao 74: 44 p.

The Program has received up to six units of effective fishing effort as descriptors of the fleet behavior in the anchovy and horse mackerel and mackerel resources fishery, such as: number of trips, average hold capacity, duration of the trip, hours of searching, total number of sets per trip and number of sets with catch (Fig. 1).



**Fig.1.** Anchovy effective effort measures in the Center-North coastal region of Perú.



*Indices of relative abundance of anchovy*

The ecosystem approach to fisheries, aims to improve management systems to optimize the social and economic benefits of fisheries; need of implementing quantifiable indicators and descriptors synthetic state of the community, who may be nominated from information available (Diaz, 2005). Thus, arising out of the information acquired from the Logbook Program we have obtained several indices of relative abundance (CPUE) (Fig. 2). Space-time observation scales may be monthly, annually, by degrees of latitude, areas, regions, etc.

**Figure 2** Relative abundance indices describing anchovy on the northern-central Peruvian coast

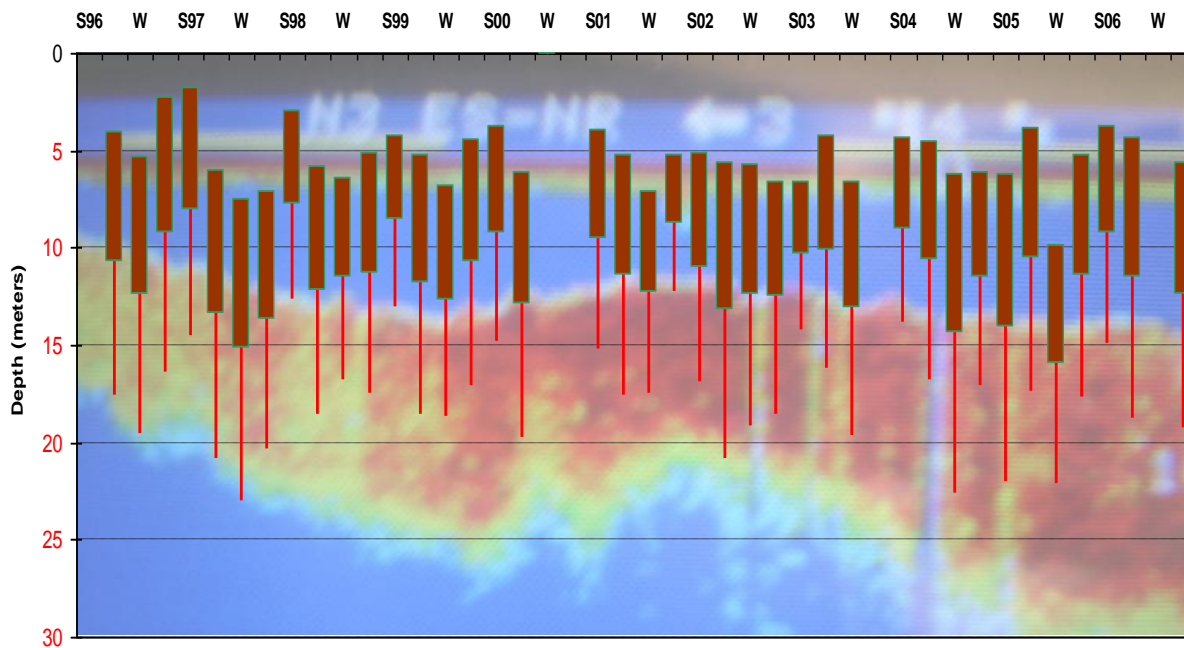
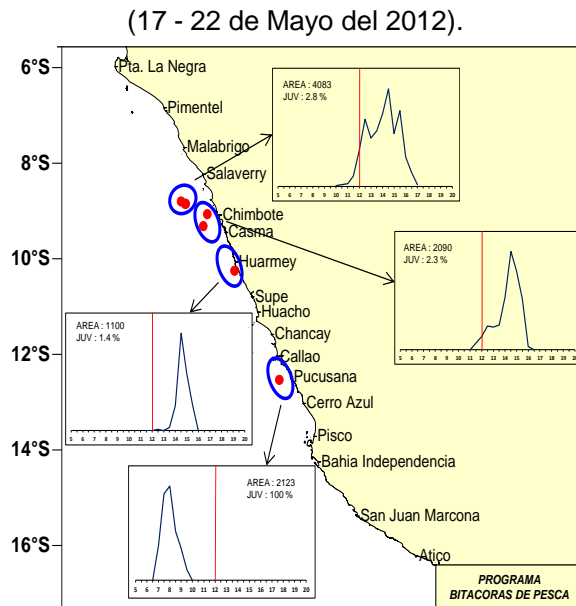
*Areas of occurrence of juvenile anchovy*

Based on the recorded positions of each set and "in situ" biometric sampling, areas of incidence of juvenile anchovy are identified. This information enables us to give recommendations to the government about closures due to incidence of juveniles (Fig. 3).

**Figure 3.** Structure by size and incidence of juvenile anchovy

*Behavior of schools of pelagic resources*

From the fishing information of the Logbook Program such as the amplitude of the vertical distribution of schools, the difference between the average top and bottom limits, we obtain the evolution of the schools behavior and some relationships that would condition it (Fig. 4).



**Figure 4.** Seasonal vertical distribution of anchovy

The information collected by the Fishing Logbook Program also allows us to identify the presence of abnormal event indicator species and therefore, provide early warnings<sup>9</sup>. Also, there is information on discards, spatial distribution of resources, behavior and population structure, interaction of purse fishing with top predators, discards, among others.

<sup>9</sup> BOUCHON M, PEÑA C. 2008. Impactos de los eventos La Niña en la pesquería peruana. Inf. Inst. Mar Perú-Callao Instituto del Mar del Perú 35 (3): 193-198.

## FISHERIES AND OCEANS CANADA'S ELECTRONIC NETWORKS: AGENTS OF CHANGE TO IMPROVE COMMERCIAL AND RECREATIONAL FISHERY MANAGEMENT INFORMATION.



Goruk, R., McConnell, C.

Fisheries and Oceans, Canada,

Fisheries and Oceans Canada, Pacific Region (DFO) has been adopting new technologies in the development of electronic logbooks (E-Logs) for Commercial and Recreational fisheries since 2005, following a nationwide initiative to modernize information systems within DFO. To meet this initiative DFO has developed E-Logs as a means to improve the quality and delivery of fisheries management and biological data and to improve the collection of scientific information.

E-Logs have been successfully deployed by DFO into a variety of net fisheries – gillnet and seine (e.g. Pacific Salmon and Herring, Greenland Halibut); in trawl fisheries (e.g. Atlantic Shrimp); pot fisheries (e.g. Pacific Prawn, Atlantic Lobster and Snow Crab) and in hook and line fisheries (e.g. Pacific Salmon – Troll and Tuna, Atlantic Halibut). Approximately 500 commercial fishers across Canada have employed the DFO E-Log software, and in some fishing fleets the application has been adopted by the entire fleet (i.e. Quebec lobster fleet and New Brunswick shrimp fleet).

The DFO E-Log software for commercial fisheries is a single application with multiple fishing modules within. Each module requires an activation key in order to become available to the fisherman or to the installer. Should a fisher be licensed for a number of fisheries, this modular approach allows the fisher simply to activate the modules he is licensed for rather than having multiple applications, i.e. one for each fishery. This approach also takes advantage of common components within the E-Log software. For example, the communications component, any changes or additions only need to be coded once with the changes/improvements being available to all E-Log modules.

The development of a single commercial E-Log module has historically been initiated by fishing associations, assisted by DFO staff, and is based on the content and design of a paper logbook (should one exist). In order for an E-Log pilot to be successful it is recommended that the number of participants is kept to a minimum (approximately 6), and that these fishers have reasonable computer skills and a good understanding of their fishery. One of the keys to a successful E-Log project to understand the day to day operations of the fishing crew and vessel and therefore it is essential for the pilot participants to be part of the development team.

Catch and other fishing information are transmitted to DFO's corporate information systems, using satellite modems (Iridium & Orbcomm) or telephones, USB Internet devices, smartphones or local area networks. Time lines for data transmission are based on the business requirements for the fishery and can be available for managers and scientists in near real time, if required. Data is sent using a comma delimited text format with XML type data tags. In order to minimize the length of the data string to data message sizes within the limits of Iridium satellite modems (~300 characters), standard or national species codes, gear codes and other codes are employed whenever possible. DFO security issues regarding data transmission have also been resolved. It is a legal requirement that fishers personal information, for example; vessel master's name, vessel name, vessel registration number to name a few, are not transmitted in the unlikely event that the data is intercepted. An E-Log identification number is issued to the vessel master which is linked to all the personal information within DFO's licensing system (Pacific Region only). The data message is sent as a simple e mail message to a mailbox on DFO's Microsoft exchange server. The data string has an identifier specific to each fishery at its beginning. When the message arrives at the mailbox it is read by an import process which deciphers the unique fishery identifier and applies the appropriate import process for the particular data string. After the data string has been read, it is imported into the data tables within DFO's corporate catch and effort database. Once the data has been sent by the fisher, it is locked down and date and time stamped.

For salmon fisheries in the Pacific Region, and as a condition of the fishers fishing license, fishers are required to obtain a confirmation number for their start trip, when they send in their catch information (also a condition of their license and is time specific) and for their end trip. These confirmation numbers are received either from a third party call in center or from DFO's corporate database, through the DFO E-Log. If the data is successfully imported, an auto

generated e-mail message with a confirmation number is sent back to the E-Log on the fishing vessel where it is automatically incorporated into the E-Log. If the data is not successfully imported, a failed message is sent back to the vessel's E-Log. A message window appears indicating there is an issue that needs addressing. The record is unlocked, allowing the fisher to correct the error and resend the data. The DFO E-Log application is a 2-way data sending and receiving system.

Fisheries and Oceans Canada has also employed a similar approach with Pacific Regions' recreational community and the Sport Fishing Institute of British Columbia (SFI) to create an electronic logbook. An E-Log has been developed based on the recreational paper logbook, involvement from a number of recreational fishers, and the SFI. Understanding the day to day operations of the guide and/or fisher has been very important in developing a software application that is workable for the recreational community.

In order to meet the business requirements of the recreational fishery, three components were developed. These consist of an "On Water" or Mobile component, a "Dockside" component and a "Lodge" component, with each fulfilling a specific requirement. The "On Water" component has been programmed using the HTML 5<sup>1</sup> approach, which has allowed this component to be deployed on to a variety of smartphones and other devices. This methodology has provided a tool for the recreational fishing community to easily record and report catch and other fishing information to DFO's corporate information systems. The "On Water" component captures catch and other fishing information for salmon, groundfish and shellfish species. In addition, a marine mammal sightings module has been included. The application has been designed and built for mobile devices with built in GPS functionality allowing catch and other fishing information to be recorded against latitude and longitude coordinates. The "Dockside" component has been designed and built for a Windows based tablet PC with touchscreen. This application captures information from fishers or guides arriving at the dock, as they are returning. The "Lodge" component captures the data from the devices through a synchronization process. Catch and other fishing information is available through a number of reports for the Lodge and/or the Lodge guests. Catch data from the "On Water" component can be displayed on maps using the built in mapping module. Catch and other fishing information is transmitted directly into DFO's corporate database using the built in communication services of the devices or is sent from the "Lodge" component using the Internet.

Programming using the HTML 5<sup>1</sup> approach has permitted modules of the E-Log (Quebec lobster) to be written for a variety of tablet devices (iPad, Blackberry Playbook). These devices can be housed in ruggedized and waterproof flexible cases, allowing deployment on to small, open fishing vessels.

E-Logs have shifted data entry to the source thus reducing data entry costs for DFO. It has also eliminated interpretation of hand written text and errors associated with transferring paper logbook data into an electronic application. Applying data entry rules provides higher quality data and helps fishers meet DFO Pacific Region's catch monitoring standards and to meet the fishers conditions of license. With this in mind, DFO is pursuing the deployment of E-Logs in all Canadian fisheries as monitoring standards are established and as DFO modernizes fisheries and its systems.

The introduction of E-Logs has led to changes within the fishing communities. Changes in attitude, data quality and ownership have been observed. For example, recording of released species diversity is significantly greater on electronic logbooks than paper logbooks in the troll fishery (2010 & 2011 99.9% confidence level). A more proactive approach and a willingness to do business differently have also been observed.

For a successful E-Log project, a number of key approaches have been identified. A full understanding of the day to day fishing operations on the vessel is essential. Keeping pilot projects small (6 to 8 vessels) is essential in order to provide support to the pilot and to deploy software updates. Also keeping data entry screens as simple as possible and keeping key punching by the fisher to a minimum is important. Having fishers involved throughout all development stages is paramount.

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<sup>1</sup> HTML 5 is a markup language using HTML, CSS, and JavaScript to create applications suitable for Android, iPhone, iPad and Blackberry devices.

## AFFORDABLE HANDHELD DEVICES FOR FISHERIES OBSERVER PROGRAMS



Gulak, S.J.B.  
IAP World Services.

### Introduction

The National Marine Fisheries Service Shark Bottom Longline Observer Program (SBLOP), based at the Southeast Fisheries Science Center Panama City Laboratory in northwest Florida, monitors catch and bycatch on bottom longline vessels in the Gulf of Mexico and U.S. South Atlantic. With the introduction of the Individual Fishing Quota Program for groupers and tilefishes<sup>1</sup> and additional longline gear restrictions<sup>2</sup> in the Gulf of Mexico, there is an increased interest in reducing the time and resources required to make data collected in the field accessible by end users. Handheld computers offer the ability for paperless data collection and electronic reporting; however, many of the industrial grade devices currently on the market are priced beyond the funds available to many observer programs. The SBLOP is currently conducting a pilot study using readily available consumer tablet computers for live at-sea data entry with daily satellite reporting. The project aims to improve data collection methods and take an important step towards real-time quota monitoring whilst maintaining data quality and cost efficiency.

### Methods

A software developer is currently under contract and in the process of designing the tablet application, which will enable the observer to record and edit gear, haul, and catch information by touch screen. Durable IP67 cases protect personal tablet devices whilst on deck. Data can then be transferred to National Marine Fisheries Service servers on a daily basis using a WiPipe hotspot device connected to a standard issue satellite phone. Initial data is received into a staging database where electronic validation is used to proof the data before final import into the main observer database. Prior to full implementation, a period of ground-truthing by recording data on traditional datasheets as well as electronically reporting data will be necessary.

### Results/Discussion

The tablet and case are less expensive than other specialized handheld devices, making paperless data collection feasible for a modest observer program. Costs are further reduced with the use of less waterproof paper and fewer hours taken with post trip data entry by program staff. The application is in the final stages of development (Figures 1-3). The staging database is completed (Figure 4). Field testing, with the datasheet comparison, is scheduled to begin in the summer of 2013.

Initial testing of the satellite data transfer suggests that the connection from the current network provider does not have the necessary upload speed to send the data. If this is the case, the observer will have to wait until returning to port before syncing with the server. Even without the ability for daily data reports from the vessel, the data pathway to the end users is still greatly accelerated. The data transfer uses standard email protocol and the email application native to the specific tablet operating system. This allows compatibility with future satellite transfer devices.

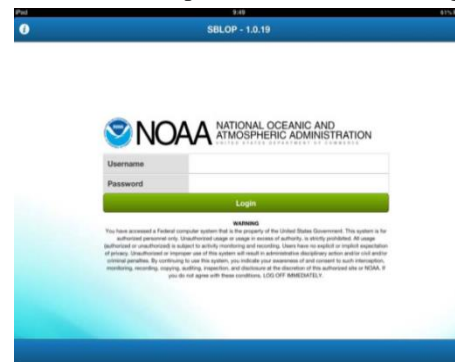


Figure 1. Login screen

<sup>1</sup> NMFS. 2009. NOAA Announces an Individual Fishing Quota (IFQ) Program for Groupers and Tilefishes in the Gulf of Mexico and Other Changes to Commercial Reef Fish Regulations. Fishery Bulletin. FB09-048. Available online at [http://sero.nmfs.noaa.gov/fishery\\_bulletins/bulletin\\_archives/2009/documents/pdfs/fb09\\_048\\_ifq\\_groupers\\_and\\_tilefishes.pdf](http://sero.nmfs.noaa.gov/fishery_bulletins/bulletin_archives/2009/documents/pdfs/fb09_048_ifq_groupers_and_tilefishes.pdf). Accessed May 29, 2013.

<sup>2</sup> NMFS. 2010. NOAA Fisheries Service Publishes Final Rule to Change Bottom Longline Regulations Affecting the Eastern Gulf of Mexico Reef Fish Fishery. Fishery Bulletin. FB10-026. Available online at [http://sero.nmfs.noaa.gov/fishery\\_bulletins/bulletin\\_archives/2010/documents/pdfs/fb10026\\_fr\\_gulf\\_reef\\_fish\\_amend31.pdf](http://sero.nmfs.noaa.gov/fishery_bulletins/bulletin_archives/2010/documents/pdfs/fb10026_fr_gulf_reef_fish_amend31.pdf). Accessed May 29, 2013.

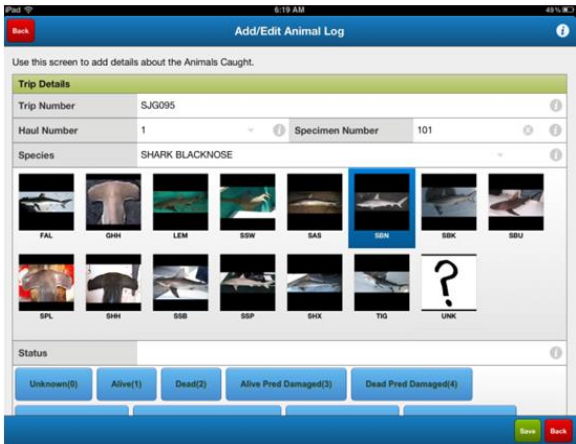


Figure 2 Animal log

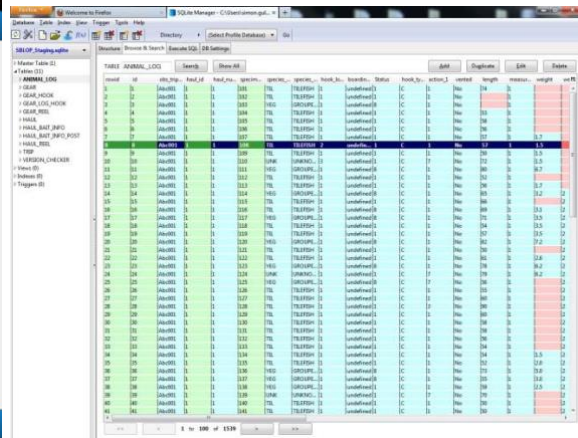


Figure 3 Species catalogue

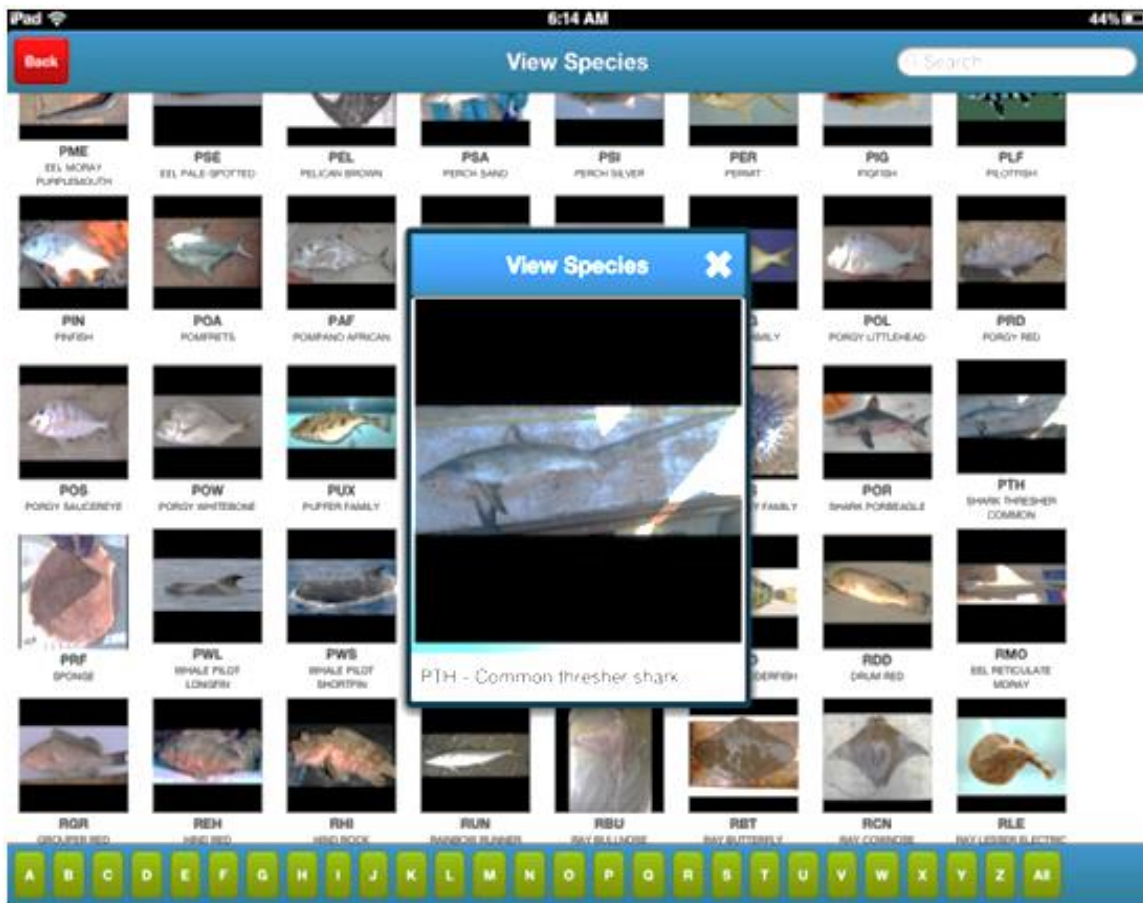


Figure 4 The SQLite staging database

This project could provide the immediate opportunity to expand electronic reporting to other atsea observer programs in Highly Migratory Species fisheries such as the shark research fishery and the pelagic longline fishery. Overall, the tablet computer and integrated data application has the potential to reduce costs and could have far-reaching implications for observer programs on a national level.



## AUTOMATIC ASSESSMENT OF TOTAL RETAINED FISH CATCH USING STEREOSCOPIC CAMERAS (3D)



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The company Ingeniería Pesquera Limitada (INGEP), in conjunction with CSIRO Earth Science and Resource Engineering and Laboratorio de Tecnología Pesquera (TECPES) are developing a system to assess the total retained fish catch in a codend or bulk piled on deck. The technology is based on the system for geological and geotechnical mapping developed by CSIRO Australia called Sirovision. This technology creates accurate, scaled 3D images of rock faces from digital images taken in open pit and underground environments. This system has been enhanced and adapted to assess the total volume of fish retained in a codend or catch bulk piled on deck. The improvements to the system deliver real time creation of 3D images that enable immediate assessment of the retained catch. CSIRO Earth Science and Resource Engineering have also developed image analysis algorithms that are capable of identifying individual fish in a catch and estimating fish size. With suitable development these algorithms can be used as the first stage or processing to identify fish species. A major advantage of acquiring 3D digital images in real time is the ability to use GPS to georeference the data on board. Then, recorded in a data management system with additional information including vessel code, date, time, latitude, longitude, vessel speed, total volume of the codend or piled fish on deck. Data recorded by the system on board can subsequently be transmitted by satellite or mobile telephone to a centralized database in land for analysis. No personnel or infrastructure is required for image reading or data typing. If further detailed analysis are required to verify and identify species composition, the system can record sequences of images of the catch when emptying the codend in to the fish hold.

## ELECTRONIC MONITORING TECHNOLOGY IN THE SOUTHEASTERN UNITED STATES COMMERCIAL REEF FISH AND SHRIMP FISHERIES



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### Introduction

With the advent of several new U.S. fishery management strategies that allocate portions of the total allowable catch to individuals or fishing sectors and more stringent bycatch reduction mandates, there has been an increased demand for fishery observer programs to provide more high-quality data in near-real time.

Since observer programs are costly to administer, there has been a redirected focus to electronic monitoring (EM) as a means to augment, or in some instances, replace traditional fisheries observers.

In the southeastern U.S., EM technology has been evaluated with video monitoring in conjunction with observers to determine the feasibility of developing a cost-effective and reliable system of monitoring finfish and protected species bycatch in the reef fish fishery. This fishery currently has 5% mandatory observer coverage for the Gulf of Mexico region. Several pilot projects discussed below were driven by the need to provide better bycatch estimates as dictated in Southeast Region's Bycatch Implementation Plan.

### Methods

Gulf of Mexico Bottom Longline Reef Fish Fishery: In 2008, the National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) and Southeast Regional Office (SERO), MRAG Americas, Inc. and Archipelago Marine Research Ltd. (Archipelago) conducted an EM pilot study to assess the efficacy of using EM to monitor bycatch (catch characterization), release mortality, handling of kept and discarded catch, and other operational practices aboard bottom longline vessels in the Gulf of Mexico reef fish fishery<sup>1</sup>. From March through

April 2008, observers collected data from 245 sets during 7 trips (108 sea days) aboard 6 longline vessels participating in the EM pilot project.

**South Atlantic Snapper Grouper Bandit Fishery:** Based on the findings of the 2008 project, a second phase was implemented in 2010. NMFS,<sup>1</sup> North Carolina Sea Grant, the reef fish industry and Archipelago conducted a pilot study to evaluate EM as a tool to characterize the commercial snapper grouper bandit reel fishery operating in the South Atlantic<sup>2</sup>. EM was deployed on 8 vessels. EM data were compared to logbooks completed by industry, and observer data. A total of 524 sea days were monitored; observer data were available for 26 of these days.

**Gulf of Mexico Reef Fish Fishery:** Findings from the 2008 and 2010 EM pilot studies are currently being used as the foundation for an Ocean Conservancy EM pilot entitled “Electronic Fishery Monitoring for Gulf of Mexico Reef Fish”<sup>3</sup>. Initial results from this ongoing study show great potential for EM use in these fisheries related to documentation of catch and discard levels. In addition, gear modifications currently being explored show promise for the length data acquisition.

### **Results/Discussion**

Findings from 2008 Gulf of Mexico bottom longline EM project<sup>1</sup> revealed 65% overall sensor data were adequately collected aboard longline vessels. Data loss was attributed to vessel operators manually turning off power to the EM units (92%) due to concerns over power draw. The remaining data loss was due to GPS signal interference and software lockups. EM sensor data provided accurate location information and identification of setting and hauling activities. As related to fish count, EM and observer data were within 2.7%. Two of three turtles were documented with EM; the one not detected was due to inadequate lighting. At the individual species level, from catch comparison between EM and observer data, 80% had positive matches. Shark, and to a lesser degree, grouper species had identification discrepancies. EM was not reliably able to assess catch discarding due to catch handling (e.g., released at rail/line cut, small specimens not brought close to camera) and camera views (e.g., angle, low lighting, blocked by crew). However, with refinement, EM could potentially provide accurate and reliable catch discarding data<sup>1</sup>.

Results from the 2010 South Atlantic bandit fishery EM project<sup>2</sup> reported that EM documented 2,580 fish. Observer data recorded 2,730 fish. On one vessel no EM data were available most likely due to the high railings on the vessel (catch being handled outside the camera view). EM data identified 85% of fish to the species level. While EM identified snapper within 1%, sharks, grunts, grouper and most notably porgies were poorly matched. On one vessel, a discard chute with a tape measure and other length indicators was used to evaluate the feasibility of improved catch identification and size estimates. As in the 2008 pilot, EM systems were turned off during a fishing trip, however were resolved through increased communication with industry. Defining fishing events posed an additional challenge making it difficult to compare the data sources (self-reported logbooks, observer and EM) and therefore justifying the need for a clear definition of what constitutes a fishing event in future investigations<sup>3</sup>

In 2003, the U.S. population of smalltooth sawfish, *Pristis pectinata*, was listed as an endangered species under the Endangered Species Act (50 CFR 224). Smalltooth sawfish have been captured in the U.S. commercial shrimp fishery and resulting estimates of the rate of take have been calculated<sup>4</sup>. However, low observer coverage coupled with the rarity of smalltooth sawfish captures resulted in low reliability in the estimate of take. To this end, EM technology is currently being advocated for monitoring smalltooth bycatch from the shrimp trawl fishery in US Southwestern Florida waters. Funding for this pilot project was received in 2013.

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<sup>1</sup> Pria, M.J., H. McElderry, M. Dyas, and P. Wesley. 2008. Using electronic monitoring to estimate reef fish catch on bottom longline vessels in the Gulf of Mexico: A pilot study. Archipelago Marine Research Ltd., 525 Head St. Victoria, BC Canada. 42 p

<sup>2</sup> Batty, A., M. Pria, H. McElderry and J. Schrader. 2011. Use of electronic monitoring for characterization of bycatch associated with the South Atlantic snapper-grouper bandit fishery. Archipelago Marine Research Ltd. 525 Head St., Victoria, British Columbia, Canada. 65 p

<sup>3</sup> National Fish and Wildlife Foundation. 2011. Fisheries Innovation Fund (Grant ID: 26493).

<sup>4</sup> Carlson, J., and E. Scott-Denton. 2011. Estimated incidental take of smalltooth sawfish (*Pristis pectinata*) and an assessment of observer coverage required in the South Atlantic and Gulf of Mexico shrimp trawl fishery. NOAA, NMFS, SEFSC, Panama City, Fla., SFD Contribution PCB-11 08, 14 p.

## EVALUATING ACCESSIBILITY AND STANDARDIZATION ACROSS U.S. FISHERIES OBSERVER PROGRAMS



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Oceana, USA.

### Introduction

In the U.S., non-governmental organizations (NGO) play an essential role in ensuring that management agencies meet legally-mandated conservation goals and often drive the development of fisheries policies that reduce bycatch. Observer data is critical in this process because it fosters greater accountability within fisheries and provides baseline levels of catch, discards, and protected species interactions that can be compared with new gear or management schemes. Organizations such as Oceana can only use this valuable information in advocating for science-based conservation policies and increased funding if the data are readily accessible, comprehensive in scope, and follow standardized reporting methods. Here we evaluate observer programs in the U.S. to identify best and worst practices in providing data useful in the advocacy arena, and conclude with recommendations for improvements.

In Oceana's work to reduce bycatch of non-target fish and protected species, we advocate for improvements in policies, research, and observer funding. For example, Oceana advocacy efforts garnered funding for pilot observer coverage for the bottom longline fishery in the Gulf of Mexico, which was previously unobserved. Without this work, we would not have discovered that over 1,000 threatened sea turtles were captured in just over a year – more than eight times the number authorized by the National Marine Fisheries Service (NMFS). Based on this information, Oceana was able to collaborate with the fishing industry and the federal government to reduce sea turtle bycatch and mortality within the fishery. More generally, Oceana was instrumental in doubling federal funding for observer programs nationwide from 2002-2008 and is actively engaged in working with the New England Fisheries Management Council to implement standardized bycatch reporting methodology. These efforts lead to better data that can be used to identify fisheries that compromise the survival and recovery of protected species and overfished stocks, as well as monitor the performance of bycatch mitigation efforts once they are put in place.

### Methods

We examine each of the twelve existing programs for (1) accessibility (whether user-friendly data are annually published online); (2) comprehensiveness (whether reporting includes protected species bycatch, fish discards, and percent coverage); (3) statistical standardization (whether catch estimates include measures of statistical uncertainty and precision); and (4) cost transparency (whether funding levels and sources are made public). This information is gathered from regional observer program website publications and the National Observer Program 2011 Annual Report.<sup>1</sup> We highlight fisheries implementing standardized reporting methodology and describe existing issues and data needs limiting the expansion of these concepts to other fisheries.

### Results/Discussion

Through this review, we show that most observer programs have accessible information, though reported data often do not include both protected species bycatch and fish discards (Table 1). Only two programs currently report measures of statistical precision and uncertainty. To implement standardized reporting methodology within additional U.S. fisheries, data must be collected and reported in consistent units over regular reporting periods according to transparent accountability measures. Once instituted, standardized data reporting will provide timely and accurate bycatch estimates that can be compared nationwide. Oceana has worked with NMFS and regional fisheries management councils to implement these changes and satisfy the legal requirement that all Fishery Management Plans establish a Standardized Bycatch Reporting Methodology.

All observer programs have published funding information, though cost-effectiveness (as measured by cost per observer day) cannot be derived from these summary figures. Improving these published statistics could benefit groups and individuals interested in using this information and advocating on behalf of observer funding. A broad comparison of cost across observer programs could also reveal situations where it would be more advantageous to create buffers surrounding catch limits to account for uncertainty when ensuring that quotas are not exceeded rather than investing funds to increase observer coverage or implement electronic monitoring.

Improvements that would facilitate data use within the NGO community include standardized reporting, including measures of accuracy, bias, and uncertainty within bycatch estimates. Oceana also recommends that programs invest in online database platforms for publishing user-friendly tables, maps, and annual reports for each fishery within the programs. Catch data must include the name, number, and weight of captured non-target fish and protected species. Continued cost transparency and consideration of alternative funding mechanisms will be critical for enhancing observer coverage and reporting capacity. In many ways, these programs administer some of the best known practices within the industry. However, this evaluation reveals issues where the U.S. still needs to improve. According to U.S. law, certain information is exempted from reporting requirements and can be designated as confidential in order to protect the identity and business of individual fishermen. However, NMFS has broadly interpreted this to include financial and operational information including catch statistics, resulting in a recent proposal to curtail the availability of this data. This action would significantly limit its use by stakeholders who participate in fisheries management. Only when data is comprehensive and consistent can we create science-based policies that ensure public trust, facilitate advocacy and funding support, improve fishing conditions, and reduce bycatch and discards.

	Accessibility		Comprehensiveness			Statistical Standards	Cost Transparency
	Online Access	Annual Reports	Fish Discard	Protected Species	Percent Coverage		
North Pacific Groundfish	✓	✓	✓	✗	✓	✗	✓
Alaska Marine Mammal	✓	✗	✗	✓	✓	✓	✓
West Coast Groundfish	✓	✓	✓	✗	✓	✗	✓
Southwest Fisheries	✓	✓	✓	✓	✓	✗	✓
Hawaii Fisheries	✓	✓	✗	✓	✓	✗	✓
Northeast Fisheries	✓	✓	✓	✓	✓	✓	✓
Gulf of Mexico Purse Seine	✗	✗	✗	✗	✓	✗	✓
Southeast Shark Driftnet	✓	✓	✓	✓	✓	✗	✓
Southeast Shark Longline	✓	✓	✓	✓	✓	✗	✓
Southeast Shrimp Trawl	✗	✗	✗	✗	✓	✗	✓
Gulf of Mexico Reef Fish	✗	✗	✗	✗	✓	✗	✓
Atlantic Pelagic Longline	✓	✗	✓	✓	✓	✗	✓

## SESSION 4

### How do programs observe and monitor artisanal fisheries?

Session lead: Oscar Guzman | IFOP, Chile.

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#### Session Description

Artisanal fisheries especially in less economically developed countries are very large, diverse, changing and sources of jobs and subsistence for high numbers of fisherman and people. These fishers also take a significant share of fisheries resources, and may be the cause of tension with industrial fishermen. Artisanal fishers are also a source of discard and incidental catch, but in many places go unmonitored. Due to cultural factors and idiosyncrasy of fisherman, an important part of success will rely on observers skills to get a good understanding and interaction with them. For these reasons, it is very complex to establish policies, management objectives and indicators, particularly to obtain structural information of the fishery (number of fishermen, boats, landing sites), and operational indicators (catch and effort).

#### Panelists

#### OBSERVERS OF THE VOLUNTARY PROGRAM OF THE ARTISANAL FISHERIES IN THE EASTERN PACIFIC OCEAN: AGENTS OF CHANGE



Rendón, L. <sup>1</sup>, Andraka, S. <sup>2</sup>, Pacheco, L. <sup>3</sup>, Segura, A. <sup>4</sup>, Hall, M. <sup>5</sup>, Voguel, N. <sup>5</sup>, Parga, M. <sup>6</sup>.

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<sup>3</sup> WWF, Panama.

<sup>4</sup> WWF, Costa Rica.

<sup>5</sup> Inter-American Tropical Tuna Commission (IATTC), U.S.A.

<sup>6</sup> SUBMON, Spain.

#### Introduction

Bycatch of sea turtles in fisheries are believed to be one of the factors leading to the decline of some turtle populations (Gilman *et al.*, 2009; FAO, 2009)<sup>1</sup>. As sea turtles are taken in many types of fishing gear such as longlines, trawls, gillnets (Lewison *et al.*, 2003, 2004a, 2004b)<sup>2</sup>, and even in ghost fishing (e.g. Anderson *et al.*, 2009)<sup>3</sup>, there are very few reliable estimates of incidental mortality for any of them, the

<sup>1</sup> Gilman, E., Gearhart, J., Price, B., Eckert, S., Milliken, H., Wang, J., Swimmer, Y., Shiode, D., Abe, O., Peckham, S.H., Chaloupka, M., Hall, M., Mangel, J., Alfaro-Shigeto, J., Dalzell, P., and Ishizaki, A. 2009. Mitigating Sea Turtle Bycatch in Coastal Passive Net Fisheries. *Fish and Fisheries J.* 2010. Vol. 11 (1):57-88.

<sup>2</sup> FAO (2009) Technical Guidelines for Responsible Fisheries. Reducing Sea Turtle Interactions and Mortality in Marine Capture Fisheries. Food and Agriculture Organization of the United Nations, Rome. ISSN 1020 5292.

<sup>3</sup> Lewison, R.L., Crowder, L.B., Read, A.J. and Freeman, S.A. (2004a) Understanding impacts of fisheries bycatch on marine megafauna. *Trends in Ecology and Evolution* 19, 598–604.

best approach appears to be to try to mitigate the impacts caused by the different fisheries without trying to shift the blame, or to spend the limited resources available in an accounting exercise to improve the estimates.

For more than 12 years, new fishing technologies and better practices have been tested in the artisanal longline fisheries of the Eastern Pacific Ocean, in 9 countries from Mexico to Peru, to reduce sea turtles bycatch, as part of an initiative implemented by governmental and non-governmental organizations, fishing sectors and other partners. Among the methods that have proven to reduce interactions and increase post-released survival of sea turtles are circle hooks, fishing gear modifications to reduce entanglements, and on-board manipulation techniques. The program has grown to become a region-wide bycatch network and the largest regional artisanal fisheries conservation program in Latin America and is described with detail in Andraka *et al.*, 2013<sup>4</sup>.

An Observer Program has been in place since 2004 and accepted voluntarily by boat owners, captains and crews. Observers have played a fundamental role to collect better scientific data available from on-board trials to understand the performance and effectiveness of mitigation measures but also as agents of change of fisher's practices and attitude. They have acted as trainers providing advice and training to fishermen in sea turtle handling and release techniques. In this paper we present some aspects related to the sampling strategy of the volunteer Observers Program and the standardization of the information collected in 9 countries in the Eastern Pacific.

### Methods

Observer Programs of each country established on-board working protocols, which were adapted to the variability and differences of longline fishing operations presented in nine countries (e.g. boats of different sizes, longline equipment and navigation autonomy), operating at regional scale in the Eastern Pacific Ocean (Table 1).

For program purposes, the role of observers was to verify the performance of circle hooks on experimental fishing lines and collect data from the entire operation for routine commercial fishing trips. Observers have had different academic backgrounds on marine sciences and fisheries technology, among others, but also fishermen have participated as observers, facilitating the adaptation to work on difficult artisanal fishing conditions. Each observer is trained in the tasks to be carried on board: data collection (characteristics of vessels, gear and fishing operational description, species identification, interaction with other species) and implementation of mitigation measures for marine turtles. In addition, tagging turtles was conducted in some countries. Standard forms were used to collect data from each fishing haul, and are supported with a field manual. During training, observers are taught the proper use of the five forms and relevant observations that must be registered. Forms and other materials used in training observers are available at the following address <http://www.iattc.org/Downloads.htm>.

### Results/Discussion

From 2004 to 2012, 11,351 sets were observed in a total of 2,564 fishing trips conducted on board 650 longline vessels from Mexico, Guatemala, El Salvador, Nicaragua, Costa Rica, Panama, Colombia, Ecuador and Peru. The biological fishery information was compiled by 255 observers on-board (Table 2). The distribution of fishing effort (fishing sets) was performed in the area bounded by latitudes 16° N and 20° S, which represents a total effort of 4,403,571 hooks observed (Figure 1). The main sea turtle species captured on trips with observers were Olive Ridley (*Lepidochelys olivacea*) and Black turtle (*Chelonia mydas*). A total of 6800 turtles were caught (entangled and hooked), 97% out of them were released alive properly. Observers had the opportunity to transfer on-board sea turtle manipulation techniques and knowledge to crew of the vessels sampled.

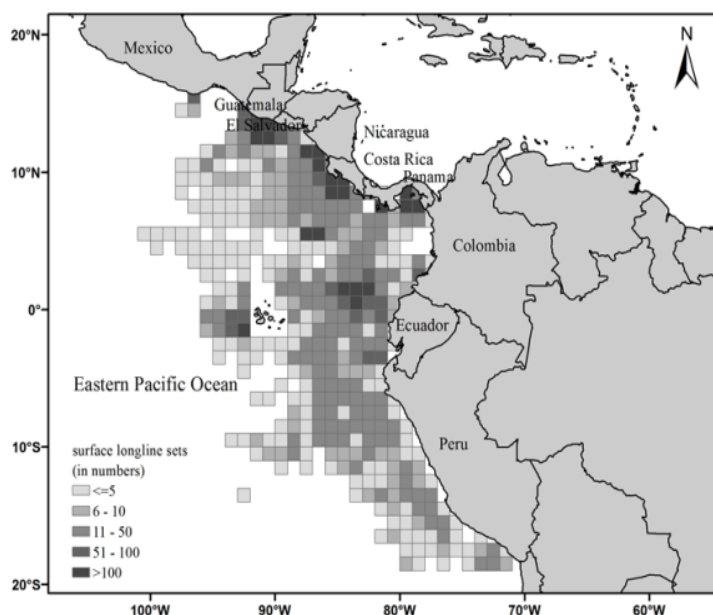
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Lewison, R.L., Freeman, S.A. and Crowder, L.B. (2004b). Quantifying the effects of fisheries on threatened species: the impact of pelagic longline on loggerhead and leatherback sea turtles. *Ecology Letters* 7, 221–231.

<sup>4</sup> Anderson, R. C., Zahir, H., Jauharee, R., Sakamoto, T., Sakamoto, I. and Johnson, G. 2009. Entanglement of olive ridley turtles *Lepidochelys olivacea* in ghost nets in the equatorial Indian Ocean. IOTC-2009-WPEB-07. 11 pp.

	Ecuador		Panamá	Costa Rica	Perú	México, Nicaragua Guatemala, Colombia
	Mother ship	Fibra				
Length overall (m)	16 – 25	6 – 8	10 -27	8 - 22	8 - 21	6 -10
Engine	Diesel, inboard	Gasoline, outboard	Diesel, inboard	Diesel, inboard	Diesel, inboard	Gasoline, outboard
Line retrieval	By hand	By hand	Hydraulic reel	Hydraulic reel	By hand - Hydraulic reel	By hand
Number of crew	4 - 8	2 - 3	5 - 8	3 - 6	5 - 13	2 – 3

**Table 1.** Characteristics of artisanal longline vessels sampled from Ecuador, Panama and Costa Rica. TBS: tunas, billfishes and sharks.



**Conclusions**

Effective fisheries observer programs can be implemented to monitor artisanal and small-scale fisheries, but a regular funding mechanism is key to maintain PO in time.

Fishermen have accepted onboard observers and have shown any change in attitude towards the improvement of better fisheries practices.

Experience developed with the voluntary PO has allowed to assist fisheries authorities on the design of their own official observer programs.

Figure 1. Distribution of fishing effort (number of sets) observed by the program between 2004 and 2010 in 1°x 1° grids.

*METHODOLOGICAL ISSUES TO ESTIMATE CATCH AND FISHING EFFORT OF SMALL-SCALE FISHERIES BY SAMPLING FISHING TRIPS ON-SITE.*

Demanèche, S., Berthou, P., Blanchard, F., Cornou, A-S., Daures, Deporte, Guyader, Lespagnol, Reynal.

IFREMER, France.

**Introduction**

Small-scale fisheries are socially important and an integral part of the European coastal zone<sup>1</sup> but are affected by a crucial lack of data all over the world and also in Europe where vessels less than 12 meters represent almost 75% of the total European fleet. In France, 75% of the fleets from North Atlantic or Mediterranean Sea have a length under 12 meters when overseas small-scale fleets (French West Indies Martinique and Guadeloupe, French Guiana or La

<sup>1</sup> Guyader, O., and al., 2013. Small scale fisheries in Europe: A comparative analysis based on a selection of case studies. Fisheries Research 140 (2013) 1-13. <http://dx.doi.org/10.1016/j.fishres.2012.11.008>.

Reunion) represent more than 90% of the total fleet. In France as well these fleets are “data poor” especially the Mediterranean Sea and Overseas small-scale fleets where declarative data (logbooks, fishing notes, sales notes, VMS data) covers less than 50% of small-scale vessels in Mediterranean Sea or La Reunion and are not at all available in other Overseas.

This paper will detail a methodology developed to collect fisheries data and estimate catches and fishing effort of the small-scale vessels by sampling fishing trips on-site. This methodology is fitted in a global Fishery Information System<sup>2</sup> elaborated since 2000 by IFREMER as provider of halieutic data for fisheries multidisciplinary works and which aim to cover all the French fleet including small-scale fleets.

After more than five years of application in different regions, it is now feasible to do a first assessment of this methodology:

Are the initial objectives reached?

What is the benefit of this collection of data and to what extent does it allow the fisheries to be monitored?

What are the successes and failures associated?

How, in practice, could such methodology be applied and with caution/logistical support?

### Methods

The methodology is applied in six regions following fleets from 150 to 1400 vessels with 2 to 6.5 observers:

Region	Set of observers involved	Number of small-scale vessels followed	Followed since
Continental Mediterranean	6,5	~1400	2007
Guadeloupe	4	~950	2007
Martinique	4-5	~1100	2007
French Guiana	6*	~150	2007
Reunion	2	~300	2005
Mayotte	4	~1000	2013

**Table 1.** Regions studied, set of observers involved, average number of small-scale vessels followed and since when.

The methodology involves a set of observers who directly interact with the fisherman at the time of their fishing trip return. It is based on the fishing fleet register (administrative data) and an auxiliary census data (the annual fishing activity calendars being collected annually by the observers for all the vessels of the region studied<sup>3</sup>) giving structural information of the fisheries surveyed (landings sites, characterization of the inactivity or activity of the vessels each month of the year, in the latter case the “metier” – gear and target species practiced and the main fishing areas). This minimal but exhaustive information allows improving and optimizing the sampling strategy and the precision of the catch and effort estimates.

Sampling schemes applied combine a cluster weighted sampling<sup>4</sup> of the fishing trips (spatial\*time sampling) with a complementary stratified phone sampling. They aim to cover, at best and regarding available financial means, the variability of catches and fishing effort between “metiers”, “fishing area” or “seasonality” by optimising the expendable sampling effort.

Cluster sampling applied involves selecting primary sampling unit (“Observation unit \* Activity day”) during which all vessels (or a maximum of them) coming back to the set of harbours considered (observation unit meaning) from a fishing trip (secondary sampling unit) are sampled about their on-going fishing trip and their

<sup>2</sup> Leblond, E. and al. 2008. The Fisheries Information System of Ifremer: a multidisciplinary monitoring network and an integrated approach for the assessment of French fisheries, including small-scale fisheries. ICES ASC 2008/K:11.

<sup>3</sup> Berthou, P. and al. 2008. From fleet census to sampling schemes: an original collection of data on fishing activity for the assessment of the French fisheries. ICES ASC 2008/K:12.

<sup>4</sup> Cochran, W.G. 1977. Sampling techniques. 3rd ed. New York: John Wiley&Sons.



weekly activity calendars. Unequal probability is used to sample larger or multi-fleet, multi-métier observation unit, and all indicators calculated on the basis of the frame survey.

Complementary stratified phone sampling involves stratifying vessels into fleets (on the basis of the frame survey allow stratifying the total fleet into homogeneous strata, sub-fleets) and to ask them about their last fishing trip and weekly activity calendar. It especially enables to increase the weekly activity sample calendar to estimate the total number of fishing trips<sup>5</sup>.

As a result of this sampling strategy, two samples are available: a set of fishing trips and a set of weekly activity calendar. The first step of the estimation strategy is to post-stratify the samples obtained by group of “métier” (frame survey allows to post-stratify the total fleet and to define the best post-stratification to be considered) because catch and fishing effort depend more on fishing activity of the vessel than on its location. Percentile bootstrap method<sup>6</sup> is applied to estimate the mean and the precision (5% and 95% threshold) of the different estimates. McCarthy and Snowden method is applied to define the size of the bootstrap samples in order to take into account the ‘finite population correction’<sup>7</sup>.

Total number of fishing trips, total and per species landings, specific effort data (gear dimension, mesh sizes, CPUE, etc.) and main fishing area fished could be estimated. Finally, the frame survey allows us to validate representativeness and coverage rate of the different samples available.

### Results/Discussion

Effort and catches estimates have been calculated in all the regions followed:

Region studied	Number of active vessels	2011 Estimates				Main Species	Sampling rate
		Number of fishing trips	+/-	Total landings in ton	+/-		
Continental Mediterranean Sea	986	130 000	15%	6 100	49%	Gilthead seabream, Mussels, Mulletts, European eel, Octopus, ...	~4%
Guadeloupe	751	61 000	10%	4 000	25%	Dolphinfish, Yellowfin tuna, Parrotfishes, Bigeye scad, Groupers, ...	~4%
Martinique	863	35 000	20%	1 700	55%	Bigeye scad, Dolphinfish, Blue marlin, Yellowfin tuna, Other tuna, ...	~8%
Reunion	190	11 900	20%	600	59%	Yellowfin tuna, Swordfish, Albacore, Dolphinfish, Mackerel scad, ...	~9%

Table 2. Results effort and catch estimates and precision associated for all regions followed

Combined with the frame survey, this survey provides a comprehensive picture of the fleets and fisheries operated in the different regions followed although operational indicators remain imprecise. The variability of catches and fishing effort between “métiers” (estimates could be calculated for all the “métiers” practised), fishing area or seasonality as well as the polyvalence of the fleets surveyed and the diversity of the catches is covered.

The Big issue remains is the low accuracy of the elevation factor (number of fishing trips) calculated on the basis of the weekly activity calendar samples. Generalization of fuel data (already tested in Guadeloupe) or implementation of geo-localization data for vessels under 15m. are the two options considered at the moment.

Finally, this methodology has to be considered within the global system. In fact, to improve efficiency of observer time on-site, the catch assessment survey could as well be used to collect (when observers have time) complementary data, such as economic or biological data or to pre-document the frame survey.

<sup>5</sup> Personal communication. Reynal, L. and al. 2013. Advantages and limitations of telephone surveys for monitoring artisanal fisheries. IFOMC Conference, Vinal Del Mar, 8-12 April 2013.

<sup>6</sup> Efron, B. and Tibshirani, R. 1993. An introduction to the Bootstrap. Chapman and Hall, New York.

<sup>7</sup> McCarthy, P.J. and Snowden, C.B. 1985. The bootstrap and finite population sampling. Vital and Health Statistics 2, 2-95.

## A PILOT STUDY FOR OBSERVING CATCH OF THE USVI SMALL BOAT FLEET



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The Cooperative Research Program of the National Marine Fisheries Service funded two pilot projects focused on methods for obtaining information from the small boat fleet of St. Thomas and St. Croix in the US Caribbean. The pilot projects addressed two primary issues: 1. The feasibility associated with placing observers onboard commercial fishing vessels in the US Caribbean including: a) Financial, space, and safety considerations for placing observers on board, b) Limitations to data collection on board and c) Coordination and cooperation issues with fishers. 2. Alternative methods of obtaining bycatch information other than to placing observers on board. Under the method explored, selected fishers returned to port with the total catch for sampling of retained and discarded components. Voluntary pilot observer projects for the small boat fisheries of St Croix and St Thomas, US Virgin Islands, demonstrated the difficulty in establishing a long-term onboard observer program. The vessels, typically less than 8m (25 ft) in length, fished primarily for finfish, spiny lobster, and queen conch using pots, traps, nets, hook and line, spears, and hand harvest. The vessels made almost exclusively day trips. Although a subset of fishers consistently volunteered to take observers, many fishers refused. To supplement observer data, we asked fishers to land all fish caught from selected trips as an alternative to carrying observers (called Captains Trips) for observation by the observers. This substantially increased the number of observations, and allowed comparison of results from onboard observers and from complete landings. This project demonstrated that fishers can bring in catch otherwise destined for discarding for later sampling by observers at the dock; in this case the observer and captain trip data were comparable. This method has potential for data collection that warrants additional research. Data collected by fishers have a high potential for bias, if fishers have something to hide or a desire to portray the fishery in more favorable light. A program that utilizes captain samples would require an assessment of the probability that bias would occur, and if the level of bias is small enough relative to the overall value of the data to justify establishing the program.

## BENTHONIC FISHERIES MONITORING SYSTEM IN CHILE: ACHIEVEMENTS AND LIMITATIONS



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Benthonic fisheries in Chile have a preponderant space in the artisanal fisheries sub-sector in terms of number of exploited resources, levels of landings, foreign exchange earned, number of fishermen involved in its fleet and proper operation. To manage these fisheries it is necessary to have data access to construct indicators that annually indicate the extractive activity applied on them. In Chile since 1985, the Fisheries Development Institute (IFOP) develops a benthonic resource monitoring program in the major landing ports of the country. This paper describes the variables collected, program objectives, the methodologies employed, the results obtained and the problems underlying data collection, especially with regard to monitoring multi-specific fisheries; fisheries development in areas distant from landing centers, the certification of the catch, the presence of the bivalve mollusks health program of (PSMB), the presence of red tide, and how each of these affect the data collection strategy. Finally, it discusses the importance and limitations of these types of programs.

## MONITORING IN THE MANAGEMENT AND EXPLOITATION AREAS FOR BENTHIC RESOURCES IN CHILE LUIS ARIZ.



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### Introduction

The Management and Exploitation areas for Benthic Resources (AMERB) in Chile, is a fisheries management measure that assigns exclusive rights of use and exploitation of benthic resources to Artisanal Fishing Organizations (OPA), who must report to the Undersecretary of Fisheries and Aquaculture (SSPA), through periodic monitoring by Technical Agencies (OTE). The National service of Fisheries and Aquaculture (SERNAPESCA) is the institution that controls all fishing activities, ensuring the fulfillment of the measure and all legal procedures related to the AMERB.

Physically, AMERBs are small coastal regions that include the water column, within this we find fisheries that are of commercial interest to artisanal fishermen. To request an AMERB fishermen organizations must conduct a baseline study (ESBA) and a formulation of a management plan and exploitation of the area (PMEA), which are sanctioned by SSPA, institution responsible of authorizing the quotas for extraction of benthic resources that are of interest to fishermen. In addition, annual or biennial monitoring of the biological-fishing conditions and fishing activity on objective species must be done. For all case studies, the OPA should hire the services of Technical Advisory group (OTE), formed by observers who are certified as professionals of marine science.

The AMERB have meant a major change in both the historical management of fishery resources and how to access these. Access has gradually switched from a free access to resources to a system of granting exclusive rights to use benthic resources, recognizing the collaborative capabilities of OPA to assume tasks of fisheries management. Although the implementation of AMERB has allowed achieving many objectives in the Chilean fishing management, conservation of resources, and fishermen have taken sustainable and friendly practices to the environment, after 15 years there are still problems that create uncertainty regarding the impact of the measure in its objective for the conservation of benthic resources.

We discuss the limitations of the studies conducted by the OTE and its causes, mainly related to the competence of the observers in AMERB, which are not required to undergo an audit or certification processes regarding their data collection processes and data management. Furthermore, it is necessary to reinforce the training and outreach of the OPA, and to encourage collaboration in the collection of data.

### Methods

A review of the regulations governing the AMERB was conducted. It describes the inclusions to be made on the technical reports from studies required for the approval of catch quotas from species that are the subject of commercial interest by the OPA, among other requirements. We reviewed and analyzed the official information that gives us the state of AMERBs management at a national level, and that was provided by the SSPA. We reviewed technical reports generated by OTE and were approved by the SSPA. On the other hand, results of the program "Tracking AMERB Fisheries" were reviewed, which IFOP is performing in its role as advisor to the SSPA, in which it must perform data standardization activities of the studies conducted by OTE.

### Results / Discussion

Amongst the 4,100 km of Chilean continental coastline, there is a total of 747 decreed management areas, covering an area of 1,161 km<sup>2</sup>. AMERB surfaces varies between 0.01 km<sup>2</sup> and 40 km<sup>2</sup>, with a median of 0.775 km<sup>2</sup>. A total of 54 benthic resources are declared as major species exploited by fisheries, with an average of 3 species per area. For the extraction of benthic invertebrate species, each species must have a quota proposal in the studies based on the results of the annual or biennial monitoring, made by OTE. Meanwhile, for benthic resources that are seaweed, there is authorization to apply extraction criteria (pruning fronds, extraction of certain sizes of plants). The current universe of fishermen involved in the areas of management as of December 2011, is 16,319, for a national total of 81,157 people. AMERBs have been applied for the past 15 years, in which the Chilean government has promoted commissioning and

maintenance through co – financing of monitoring studies, that have been carried out by a total of 74 OTE and are currently operating a total of 33 OTE.

There are errors in the spatial location of the areas boundaries, and sampling units, caused by not using standard protocols for spatial data sampling (misuse or unreported datum). Results in errors reported in the estimates of surface distribution of the species under study, as well as estimates of abundance have consequences on estimated quotas. In addition we found that the formats established by the SSPA for data delivery are not always met, which limits the temporal analysis of time series, reducing, the predictive value of biological fishing variables of interest needed to evaluate the status of fisheries.

Moreover, to evaluate the productive performance of the AMERB's, it is important to collect data of fishing (harvesting) activities on the main species, which is generated by the extraction of authorized quota. However, harvest information is the least reported in the reports. The omission in the delivery of this information is explained in the misconception of the OPA, who think that this activity must be the work of the OTE. Also, the regulation is not rigorous, which leads to the delivery of reports with information gaps. The OPAs have responsibility in this situation, either by lack of capacity to collect data or by weaknesses inherent in organizational management. This can be addressed under a program of outreach and training to the OPA.

Although AMERBs help the conservation of benthic species, and also helps to ensure the sustainability of the fishery, these purposes are being tested by the omissions of the OTE. The diversity and lack of rigor in the use of methodologies for data collection and estimates of abundance and fishing quotas, the non-compliance in data delivery formats, the lack of information on fishing activity, and only partial fulfillment of the instructions for the delivery of data according to established formats are issues that relate to the lack of control mechanisms requiring the OTE to undergo audits or certification processes of their sampling processes and data management.

Finally, the actions to be taken to improve the system AMERB relies on the responsibility of fisheries authorities. Decisions can be considered in order to subject to the OTE some accreditation process. It would help to create standard protocols for data collection. Regarding the OPA, it is recommended strengthening outreach activities of the research results for AMERB and to strengthen the capacity of organizations to actively participate in the data collection.

## CHALLENGES FOR SCIENTIFIC OBSERVERS COLLECTING DATA FOR BENTHIC ARTISANAL FISHERIES IN TUBUL, BIO BIO REGION, CHILE.



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The artisanal fishing fleet monitored in Tubul, was formed this year by 387 registered boats that offload their catches in this cove. These boats operated primarily on the basis of monospecific fishing trips, extracting resources from 7 different areas with landings totaling 3693 metric tons (t). This amount represents a 13% increase compared to 2010 when 3266 t were reported. It has also been noted there was a marked increase in landings of razor clams, which reported an annual catch of 1259 (t), a value 946% higher than the reported in 2010. In contrast landings of taquilla clams decreased by 43%. The marked increase in razor clams landings reflects a new fishing method applied by divers, as some of them use the slapping technique, which involves taking large amounts of the resource by hand, which is less selective method in size but increases yields per hour. It has also been seen that many fishing vessels offloaded small specimens, which are not always accessible for observers to collect length data required because buyers at the beach often restrict the access for sampling. Regarding razor clams (*Ensis macha*), no landings were recorded during the fishing closure period, between October and November. However, once the fishery was open, a sharp increase in reported catches was observed, with the biggest catch of the year registered in December with a value of 523.6 (t). Landings are made in a large beach area at the mouth of the Tubul river, located in the province of Arauco. The distribution of landings is arbitrary, determined by the buyers' location on the beach, as they have agreed to purchase

catch from a number of fishermen. Approximately four observers conduct the surveys and samplings. In order to facilitate the work, the observers divide the number of buyers to be monitored. The main difficulties are the large number of vessels landing their catch at the same time making it difficult to survey them all.



Observer Derek Kudda introduces the art of Gyotaku painting.

## SESSION 5

### How best to monitor recreational and pay-for-hire (charter) fisheries

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#### Session Description

Recreational and pay-for-hire (charter) fisheries are very large and valuable in many countries and can take a significant share of the fisheries resources. These fisheries are highly diverse and in many places go unmonitored. This situation is changing and in this session we examine the logistics of monitoring and observing catches (both retained and released) in these fisheries.

#### Panelists

#### USING MULTIPLE DATA SOURCES TO MONITOR RECREATIONAL FISHERIES ON THE PACIFIC COAST OF CANADA

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<sup>2</sup> British Columbia Sports Fishing Advisory Board.

Recreational fisheries on Canada's Pacific coast are large and diverse. These fisheries occur in both protected and exposed coastal areas as well as up to 50 km offshore. Fishing is most commonly angling with a rod and reel from a boat; however, the recreational licence permits invertebrate trapping, shore-based bivalve collection, and more rare harvesting modes, such as spearfishing while diving. Primary species harvested include: chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*) and sockeye (*O. nerka*) salmon; halibut (*Hippoglossus stenolepis*); dungeness crab (*Metacarcinus magister*) and spot prawn (*Pandalus platyceros*). Recreational fishing developed in this area in the late 1940's with very rapid growth through the 1970's. Effort peaked in 1984 with approximately 2.5 million angler days. In recent years effort has been about one million angler days per year with an average of 314,000 licences (2003-2012) issued annually. The magnitude and diversity of this fishery makes monitoring challenging.

A combined access site interview and aerial effort 'creel survey' was instituted in 1980 and remains the primary method to estimate recreational boat-based angling catch<sup>1 2</sup>. Our creel survey staff are essentially dockside monitors in this fishery and target an interview rate of 10% of returning anglers. This method provides fisher-independent data for retained catch and effort and provides an opportunity to collect biological samples from catch. This method is very expensive and only the peak summertime fishing season is currently surveyed. In addition, the fishery has changed – particularly in terms of spatial extent, distribution of effort, and target species - over the last forty years leaving gaps in monitoring coverage in time and space.

<sup>1</sup> English, K., G. Searing and D. Nagtegaal. 2002. Review of the Strait of Georgia recreational creel survey, 1983-1999. Canadian Technical Report of Fisheries and Aquatic Sciences, 2414. 81pp.

<sup>2</sup> Zetterberg, P., N. Watson and D. O'Brien. 2012. Strait of Georgia recreational fishery statistics for salmon and groundfish, 2010. Canadian Manuscript Report of Fisheries and Aquatic Sciences, 3000. 106 pp.

In a process including fisher input, Fisheries and Oceans Canada have been working to improve monitoring in the recreational and other fisheries on the Pacific Coast<sup>3</sup>. Two new methods are currently being evaluated to fill gaps in the existing creel survey.

From 2010 to 2012 a pilot logbook program has targeted the for-hire component of the recreational fishery. Lodge-based electronic manifests and personal paper and electronic logs<sup>4</sup> have been provided to guides and recreational for-hire businesses in selected areas. These methods provide fisher-dependent catch for logged fishing trips and are particularly useful in remote areas where the for-hire component of the fishery is prevalent. Fishing guides are expert anglers who can be trusted to correctly identify abundant species. Logbook participants also provide an opportunity for the collection of biological samples from catch. The logged catch data are combined with creel survey data to estimate catch where the two methods operate in concert.

A novel approach using the internet to survey licensed anglers is also being trialed. The Internet Recreational Effort and Catch survey (iREC) has been operated since July 2012 at monthly or shorter intervals. This is an inexpensive method to collect estimates for lower effort ‘off-peak’ periods, like the fall and winter, where creel surveys are inefficient. The iREC survey covers all Canadian coastal Pacific waters, leaving no spatial gaps. During this trial period the iREC survey is being operated concurrently with creel surveys to develop relationships between estimates from the two methods. These relationships may be used to allow bias correction for future iREC estimates as preliminary analysis suggests iREC estimates may be biased low relative to creel survey estimates.

For each survey period a small sample of license holders (~1%) are randomly selected to participate in the survey. Participants are emailed an individual survey link which is active for the entire survey period plus two weeks. The survey can be accessed multiple times and participants are encouraged to use the survey like a diary to minimize recall bias. The survey is designed to be quick and easy to fill out and contains links to fishing regulations and species identification information. More than 35,000 license holders were selected to participate between July and December 2012 and response rates to the voluntary survey have varied between 21 and 37%. We plan to continue operating iREC as a trial through 2013.

**Table 1.** The percentage of iREC respondents reporting recreational fishing via one of six harvest modes during March and July 2012. Fishing modes in *italics* have not been monitored previously.

Harvest mode	March	July
<i>Angle from boat</i>	42.6%	72.8%
<i>Trap from boat</i>	13.8%	16.1%
<i>Angle from shore</i>	31.1%	7.1%
<i>Trap from shore</i>	2.8%	1.6%
<i>Beach collecting</i>	8.9%	2.1%
<i>Dive-based or other</i>	0.7%	0.4%

Unlike creel and logbook methods, the iREC survey approach collects fisher-dependent information on all modes of fishing permitted under the recreational license. Data on effort and catch from shore-based angling and trapping as well as beach collecting of invertebrates and spear fishing are being collected for the first time. There is evidence of changes in the proportion of respondents engaged in the different recreational harvest modes through months of the year (Table 1).

As budgetary pressures on recreational fishery monitoring increase, we are turning more to relatively inexpensive fisher-dependent sources for monitoring data. Perhaps even 100% fisher reporting in the recreational fishery is possible as electronic technology improves the ability of participants to easily provide their catch information. In the future perhaps creel surveys could serve as a fisher-independent audit of fisher-dependent data; the frequency of that audit dependent on the management and biological risks of a particular fishery.

<sup>3</sup> Eros, C. Session 10 - this volume; “An ecosystem and risk-based approach for assessing and identifying levels of fisheries monitoring programs on Canada’s Pacific coast”

<sup>4</sup> Goruk, R. Session 3b – this volume; “Fisheries and Oceans Canada’s Electronic Networks - Agents of Change to Improve Commercial and Recreational Fishery Management Information”

## ASSESSMENT OF THE BIOLOGICAL IMPACT OF THE RECREATIONAL FISHING IN THREE NON-MANAGED SITES ALONG THE NORTH-WESTERN FRENCH MEDITERRANEAN COAST



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### Introduction

Recreational fishing is one of the most frequent leisure activities in coastal zones worldwide, and it involves large numbers of people and consequently high levels of fishing effort<sup>1</sup>. The real impacts of this activity on the Mediterranean fish assemblages are not yet known. Despite this fact, marine recreational fisheries are not monitored with the same rigor as commercial fisheries. In the Mediterranean Sea, recreational fishing is particularly important, representing more than 10% of total fisheries production in the area<sup>2</sup>. Despite their regional importance, few studies have focused in Mediterranean recreational fisheries<sup>3 4 5 6 7</sup>.

This project, supported by an European Fisheries Fund grant, aims to create a survey network to monitor fishing activities and fish assemblages along the coastline of the Var department (North-Western French Mediterranean Sea; 432 km length). It constitutes the first investigation dealing with the recreational fishing along the French Mediterranean coast. The study focused on coastal recreational boat fishing activity since it is the recreational fishing type most often practiced in the three areas surveyed. The inquiries aimed to assess the biological impact of this leisure activity on fish assemblages.

### Methods

Three areas were surveyed: the Cap Roux area, the Embiez island and the Dramont/ Vieilles area. These three sites are located along the coastline of the Var department. The Cap Roux area was monitored from April to October 2009. Within this area, a no-take area has been set up since 2003. All types of fishing are forbidden, and the fishing activity occurs only in the north or in the south of the protected area. However some fishermen were interviewed inside the protected area. The two other sites are unmanaged sites and were surveyed from May to September 2012. In each case, the surveys covered the peak season which is the preferred season for most of the fishers in the different areas surveyed. Fishermen were interviewed using a roving technique because the access points to the fishing areas are numerous and difficult to identify. A total of 305 boats were interviewed using questionnaires filled out by the authors according to the answers of the fishermen (527 fishermen) in order to know their fishing habits. In addition, each fish caught by fishermen was identified, weighed and measured

### Results/Discussion

A total of 3947 fishes belonging to 47 species (17 families) were identified. Whatever the site, one species was largely dominant *Coris julis* (Labridae) (Table 1), both in terms of abundance of the total catches (more than 30 %) and in terms of weight (more than 20 % of the biomass caught). Two others species also represented the most part of the

<sup>1</sup> Lloret, J., N. Zaragoza, D. Caballero, and V. Riera. 2008. Biological and socioeconomic implications of recreational boat fishing for the management of fishery resources in the marine reserve of Cap de Creus (NW Mediterranean). *Fisheries Research*, 91: 252-259.

<sup>2</sup> EU. 2004. Mediterranean: guaranteeing sustainable fisheries. *Fishing in Europe*. 21, 12 pp.

<sup>3</sup> Morales-Nin, B., J. Moranta, C. García, M.P. Tugores, A.M. Grau, F. Riera, and M. Cerdà. 2005. The recreational fishery off Majorca Island (western Mediterranean): some implications for coastal resource management. *ICES Journal of Marine Sciences*, 62(4): 727-739.

<sup>4</sup> Cardona L., D. Lopéz, M. Sales, S. De Caralt, and I. Diez. 2007. Effects of recreational fishing on three fish species from the *Posidonia oceanica* meadows off Minorca (Balearic archipelago, western Mediterranean). *Scientia Marina*, 71(4): 811-820.

<sup>5</sup> Font T., and J. Lloret. 2011. Socioeconomic implications of recreational shore angling for the management of coastal resources in a Mediterranean protected area. *Fisheries Research*, 108: 214-217.

<sup>6</sup> Lloret J., and T. Font. 2013. A comparative analysis between recreational and artisanal fisheries in a Mediterranean coastal area. *Fisheries Management and Ecology*. Available online doi: 10.1111/j.1365-2400.2012.00868.x.

<sup>7</sup> Font T., J. Lloret, and C. Piante. 2012. Recreational fishing within Marine Protected Areas in the Mediterranean. *MedPAN North Project*, WWF France, France, 168 p.



catches: *Serranus cabrilla* and *S. scriba* (*Serranidae*) as observed in similar studies (Font et al., 2012). Moreover among the sampled species, two threatened species were noticed: *Pagrus pagrus* and *Labrus viridis*, included in “endangered” and “vulnerable” categories of the IUCN Red List respectively. In Dramont/Vieilles site, *P. pagrus* catches can reach more than 5 % of the caught biomass (Table 1). The same pressure of recreational fishing activity on threatened fish species was observed in Cap de Creus, Spain<sup>8</sup>.

According to the inquiries, the fishing effort was high since fishers fish an average of 3h45/day, 7 days/months and nearly 5 months/year around each site, a fishing effort similar to previous studies<sup>1</sup>.

As recreational fishers used relatively most of the time similar fishing methods (handline, pole-line, longline) no distinction in the CPUE calculation was made. CPUE were then calculated, gathering all species and fishing methods. The mean calculated CPUEs (SE) (D/V: 110.06 (3.15) g/hook/h; E: 159.73 (3.9) g/hook/h; CR: 82.7 (2.0) g/hook/h) are comparable to Cap Creus MPA (90.2 g/hook/h for bottom fishing rod1), but lower than the mean CPUEs obtained in Cerbere-Banyuls MPA (326.9 g/hook/h/fisherman<sup>9</sup>).

	Abundance	(% total catches)		Biomass (% total catches)		
	E	D/V	CR	E	D/V	CR
<i>Coris julis</i>	<b>53.48</b>	<b>36.81</b>	<b>42.02</b>	<b>32.69</b>	<b>21.42</b>	<b>26.64</b>
<i>Serranus scriba</i>	4.09	17.46	15.17	27.59	19.01	16.73
<i>Serranus cabrilla</i>	27.00	23.22	14.90	6.02	12.32	15.02
<i>Spondyliosoma cantharus</i>	0.70	2.52	9.90	2.25	3.72	12.04
<i>Boops boops</i>	3.04	6.93	2.14	4.70	10.32	3.05
<i>Pagrus pagrus</i>	1.40	2.61	0.27	3.59	5.49	0.59
<i>Diplodus annularis</i>	0.58	1.89	3.21	0.90	2.61	3.94
<i>Labrus merula</i>	0.12	0.09	0.45	0.29	0.96	2.48
<i>Spicara sp.</i>	3.57	3.06	1.52	7.11	5.15	2.39

**Table 1.** Abundance and biomass (percentage of the total catches) for some key-species in the three sites (E: Embiez; D/V: Dramont/Vieilles; CR: Cap Roux).

For one site, les Embiez island, the fished surface is easily bounded (215 ha), allowing an extrapolation of the biomass removed by the fishermen: 3.2 tons/year. It is equivalent to ca. 69% of the total biomass annually extracted by a single artisanal (commercial) fisherman in the same area.

Despite the limitations of the study, particularly since it does not include data on spear fishing, and angling from the coastline (i.e. without boat), and the constraints associated to onsite survey methods such as the difficulties to estimate total catch and effort and the lack of a registry or license requirement for anglers, our results confirm that abundance of two main fished species, *Coris julis* (especially males) and *Serranus cabrilla*, are good indicators of the fishing pressure. They also highlight that the pressure the recreational boat fishing activity exerts on fish assemblages is important in comparison of the professional fishing activities. Consequently, recreational fishing needs to be considered when developing an efficient management of the littoral areas.

<sup>8</sup> Lloret J., and T. Font. 2013. A comparative analysis between recreational and artisanal fisheries in a Mediterranean coastal area. Fisheries Management and Ecology. Available online doi: 10.1111/j.1365-2400.2012.00868.x.

<sup>9</sup> Font T., J. Lloret, and C. Pianté. 2012. Recreational fishing within Marine Protected Areas in the Mediterranean. MedPAN North Project, WWF France, France, 168 p.

COMPARISON OF PAMLICO SOUND AND COASTAL ATLANTIC OCEAN STRIPED BASS, MORONE SAXATILIS, RECREATIONAL ANGLING SUCCESS.

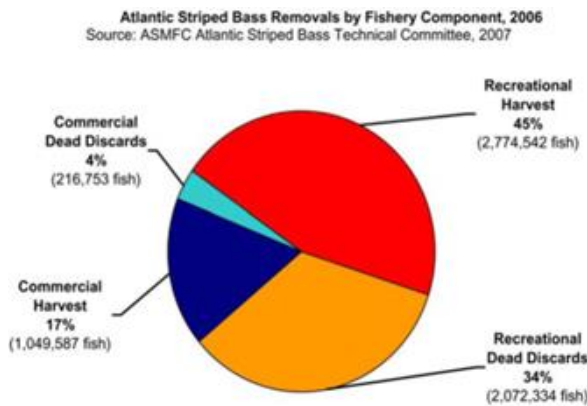


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**Introduction**

Striped bass, *Morone saxatilis*, is a very important fish species both ecologically, recreationally and commercially. This species has a large geographic range, a unique lifestyle and an interesting method of reproduction. The area of interest in this study is the Pamlico Sound of North Carolina, the second largest estuary in the United States, and a valuable striped bass habitat<sup>1</sup>. Due to the Tragedy of the Commons, a theory that people will extract more than their fair share of natural resources when given the chance, there is a need for fisheries management<sup>2</sup>. The study was designed to evaluate the success of different populations of recreational striped bass anglers in two independently managed areas, the Pamlico Sound and the Atlantic Ocean coastal striped bass populations. My survey was conducted to gather catch per unit effort (CPUE) data and determine the overall landing success of recreational anglers intercepted during a week-long study. My data showed a statistically significant difference in the success of coastal Atlantic Ocean anglers and their more successful Pamlico Sound counterpart. I observed ten landed striped bass, all of which came from the Pamlico Sound. CPUE for the Pamlico Sound was 0.1 in comparison to 0.0 at the Ocean study sites. I completed a biological assessment of the species as well as a study of the current fisheries management regulations to best evaluate the data collected.



**Figure 1.** Depiction of the fraction of the whole each sector harvested in 2006. The graph is representative of the catch in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. The relationship between recreational and commercial fishing highlights the importance of data collections from recreational anglers.

**Methods**

In order to evaluate the landing success of recreational striped bass anglers in the Pamlico Sound and the Outer Banks coastal Atlantic Ocean, I designed an angler survey. The survey asked specific questions as to the style of fishing, amount of effort, catch data, personal fishing history, and attitudes towards management. The goal was to interview 100 striped bass recreational anglers at the conclusion of their fishing day. Of those 100, 50 would be Pamlico Sound anglers and the remaining from the coastal ocean anglers. I surveyed all willing anglers without bias to catch or location. There was equal time given to reaching ocean anglers and Sound anglers on both weekends and week days. The study took place from March 12-20, 2011 on the Outer Banks of North Carolina. The study focused on anglers from the Pamlico Sound and the coastal areas Atlantic Ocean along the proportionate strip of the Outer Banks.

I created the survey to most effectively grasp what type of angler is most successful at landing striped bass in the coastal region of the Outer Banks and in the Pamlico Sound, and identify which part of the recreational fishery puts the most pressure on the stock. Carefully written questions avoided adding bias to the survey respondents' feedback. I avoided words like better, worse, success and failure in the questions. The Marine Recreational Fisheries Statistics Survey (MRFSS) is used on the Atlantic and Gulf Coasts as a management tool to estimate fishing effort and obtain creel

<sup>1</sup> Bain, M. B. 1982. Habitat suitability index models: Coastal stocks of striped bass. U.S Department of the Interior, Fish and Wildlife Service. Biological Services Program. FWS/OBS-82/10.1.

<sup>2</sup> Hardin, Garrett. 1968. "Tragedy of the Commons." Science.

survey data. The questions used in my survey asked similar directed questions, but also included qualitative questions about management practices not included in MRFSS.

The following questions were considered quantitatively after processing the data for trends: fishing location, fishing method, time spent with gear in the water and fish size information. Data was averaged and individual standard errors were calculated for the responses. Additional questions provided a qualitative assessment of fisheries licensing and specific management recommendations: support of Coastal Recreational Fishing License, suggestions for management officials, and plans for the fish. Extra questions were included to make sure any additional patterns or trends in the data that I had not anticipated were recorded such as distance traveled from home to fishing site, other targeted species in other seasons and gear type.

### **Results**

The goal of interviewing 100 striped bass anglers who had fished that day was not met successfully, but there was substantial data collected. Over the course of the week, 62 interviews were conducted, 43 with striped bass anglers and 19 with tuna anglers. The small number of tuna fishing surveys did not yield enough data to use in this study.

Of all the anglers approached to interview there were only three individuals who declined. The 43 striped bass anglers interviews yielded 10 striped bass in 143 hours of fishing effort, producing a catch per unit effort of 0.070 (fish/hour) for the survey respondents. Catch per unit effort (CPUE) is defined as the number of landed fish that were caught, found to be of legal size, and removed from the ecosystem, divided by the number of hours spent actively fishing. This number is a way of standardizing data from different fishing trips, days, and locations.

Twenty-six of the striped bass anglers interviewed fished in the Pamlico Sound. There were 100.5 documented hours of active fishing, with an average of 3.9 hours per angler. With a total of 10 keeper striped bass caught in the Pamlico Sound, there was a CPUE of 0.100 (fish/hour) for this group. Anglers who targeted striped bass from a boat made up about half of the striped bass surveys at 21 individuals. Together the boat-based anglers caught 8 fish in 83 hours of effort, with the average angler actively fishing for 4.0 hours. A resulting CPUE of 0.096 (fish/hour) was slightly lower than the average CPUE for the Pamlico Sound. The remaining 5 anglers who targeted striped bass in the Pamlico Sound fished from piers and landed 2 striped bass in 17.5 hours. CPUE for this group was 0.0114 (fish/hour) and the average time spent actively fishing was 3.5 hours.

There were 17 anglers interviewed whose fishing efforts were in the Atlantic Ocean. These anglers exerted 42.5 hours of effort and produced no striped bass, resulting in a CPUE of 0.0 (fish/hour). One boat trip into the ocean was made by these anglers. Six anglers were onboard, each fished for 2 hours, resulting in 12 hours of boat based ocean effort. Eleven anglers were intercepted and interviewed after fishing from the shore. Cumulatively they fished for 30.5 hours with an average time of 2.8 hours with gear in the water.

The CPUE was evaluated by dividing the number of fish landed and brought back to the dock by the number of hours actively spent fishing. Striped bass catch for the Atlantic Ocean at the time of study was documented as 0 fish in 42.5 hours of effort which produced a CPUE of 0 (fish/hour). The fishing efforts in the Pamlico Sound produced 10 fish in 100.5 hours of effort. This resulted in a 0.100 (fish/hour) CPUE for the Pamlico Sound. The standard deviation with the small sample size is relatively large. A t- test reveals that the difference between the ocean and Sound anglers is statistically significantly different at the 0.05 critical level.

## MANAGEMENT AND ASSESSMENT IMPLICATIONS FROM A LACK OF DATA ON DISCARDS IN RECREATIONAL FISHERIES FOR PACIFIC HALIBUT



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Recreational fisheries for Pacific halibut (*Hippoglossus stenolepis*) in the North Pacific Ocean represented 12% of the total annual removals in 2011. Until recently, recreational fisheries have been managed with daily bag limits, possession limits, and season restrictions. Increasing sport harvests in some areas has led to the introduction of size limits, including reverse slot limits, to keep harvests within catch limits. Size limits have several consequences, including an increase in discards and a change in fishery selectivity. Recreational fishery harvests are currently monitored by dockside sampling programs and logbooks. Little is known about the quantity discarded; there is no at-sea monitoring, and instances of where discard data are provided comes from unverified self-reporting. The emerging use of size limits as a management tool creates different selectivity for sport gear in those areas. The quantity of discards is unknown since they are not landed for sampling. Without such sampling, inadequate information is available to inform the stock assessment about discards, creating the potential for bias in the assessment results. Sampling solutions may be difficult to achieve, as the agency responsible for the assessment, the International Pacific Halibut Commission, has no role in the sampling and monitoring programs, which are conducted by U.S and Canadian state and federal agencies. Until a solution is found, the assessment should adopt a conservative approach to reduce the potential bias and, when possible, fishery managers should employ fishery restrictions which minimize discards. In addition, substitute monitoring approaches should be identified. Also, analysis of longline assessment survey catches could be used to provide an estimate of recreational fishery selectivity.

## MONITORING ARTISANAL FISHERIES IN THE BASQUE COUNTRY: (SKIPPERS INVOLVEMENT AND PARTICIPATION IN THE DATA COLLECTION PROCESS)

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### Introduction

Artisanal fisheries are very important in many Countries from the socioeconomic and ecological points of view for which the Basque Country is not an exception. As typical for many artisanal fisheries, the Basque artisanal fleet is polyvalent in terms of gears and target species, developing a seasonal activity which involves a large amount of species of high diversity and a variety of different names for the same species.

Despite the importance of these fisheries, scarcity, limited access and/or low reliability of data and information on artisanal fishing are constraining the implementation of efficient management programs. This is the main reason why a survey of the fleet is required to improve the knowledge about its activities. To this aim it has been of fundamental importance the skippers' involvement in the data collection process.

### Methods

A survey was conducted for all active skippers located at Basque Country fishing ports, using questionnaires designed to compile required information on fishing practices, socio-economics, fish selling channels, equipment etc. Data from 2008-2010 was obtained, and the Fleet Census was updated (official active vessels vs. real active vessels). The survey was conducted as described below:

A logbook was given to each of the skippers of the artisanal fleet. This log-book had to be filled out every day when there was fishing activity. The required data were: catches, gear, effort, fishing location, prices, vessel technical characteristic (GT, Power, total length).

- For socio-economic data, specific surveys were also designed to inquire about information on exploitation costs, revenues and investments and other issues related to the commercial optimization of fish products, and possible diversification activities.
- For discards sampling a self-sampling scheme was used. Some skippers were selected and trained for this purpose by scientific staff.

Also a pilot study was carried out on Vessel Monitoring System via Automatic Identification System (AIS) for new and updated geo-referenced information useful for spatial planning management of artisanal fisheries.

### **Results**

Different métiers and target species were identified. Ports were also classified taking into account landings and number of vessels. A socio-economic characterization of the fishing activity was also developed, as well as an integrated and dynamic bio-socio-economic model (DPSIR model) in order to improve fisheries management. Finally, discards and selectivity results were calculated for the selected gears.

The involvement of the skippers created observations of artisanal fisheries where different stakeholders participate in the management decision process (in contrast to the more traditional “top-down” process).

In the case of the pilot study using Vessel Monitoring System via Automatic Identification System (AIS) tools, the system had been validated and data in real time was obtained from the pilot study vessels.

## *ADVANTAGES AND LIMITATIONS OF TELEPHONE SURVEYS FOR MONITORING ARTISANAL FISHERIES*

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IFREMER, France.

### **Introduction**

In Martinique, one thousand artisanal units spread over nearly 100 landing points along 350 km of coastline, fishing for less than 24 hours trips are our universe of vessels in this study. This multi-gear (12 gear types and more than 50 métiers involved) and multispecies fishery (182 species, 127 in the fish pots and 118 in gillnets) bring back ashore small quantities of fish (average output: 13 kg for fixed gillnets and 80 kg for the beach seine), throughout the day, directly to the sale spots where the observer is hampered because of the crowds there.

### **Methods**

The monitoring of this kind of fishery by telephone survey has been conducted for 4 years. It eliminates the constraints of poor access to certain sites, working long hours and lack of permanent availability of the observers. Indeed landings are more frequent between 07:00 hours and 20:00 but happen all the day long (fig.1). The proportion of fishing trips is higher between Tuesday and Thursday for pelagic fishing and on Saturday for pots (fig. 2).

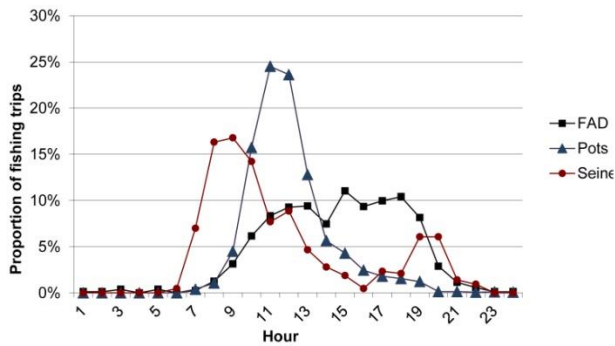


Figure 1: hours of landings (2008-10)

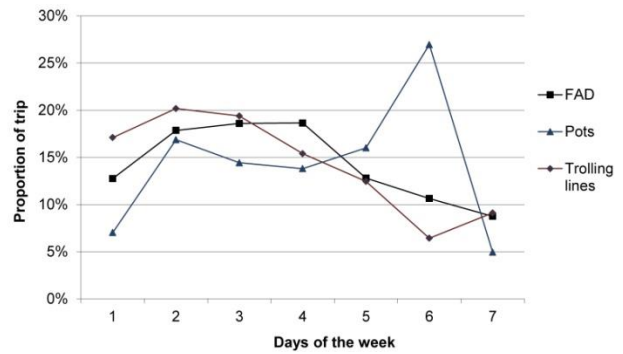


Figure 2: Days of fishing (2008-10)

These surveys are conducted according to a stratified sampling based on a simple weekly stratified random sampling of boats inside 25 strata based on the boats lengths, fishing distance from the coast and mooring area. Each week, 75 captains must therefore be investigated by telephone : (1) to reconstitute trips and inactivity on the last seven days (weekly activity calendars) and (2) to collect effort and landings occurring for the last trips. Each year, an average of 3,300 surveys, covering seven days, were done. Throughout this survey, the number of fishing trips and their main features (effort, landings and variable costs) are estimated.

Data validation has been made by matching the estimates with other surveys held in parallel and with the results of other independent studies (fish consumption per capita, customs data, etc.).

These phone surveys are supplemented by biological sampling. But for multispecies fishing, like pots of nets, the fishermen are often selling their products almost during landing. So there is an important pressure of customers and no place and no time for biological sample. A “fast sampling” is done by photography, in order to reduce the nuisance for the fishermen in their activity. The fishes are displayed on a clean carpet and photographed (fig. 3) and the carpet sample is weighted. Then the fishes are identified and measured in the lab with special software, by giving the dimension of the carpet (see left side of the screen, fig. 4).



Figure 3: photography of fishes rapidly

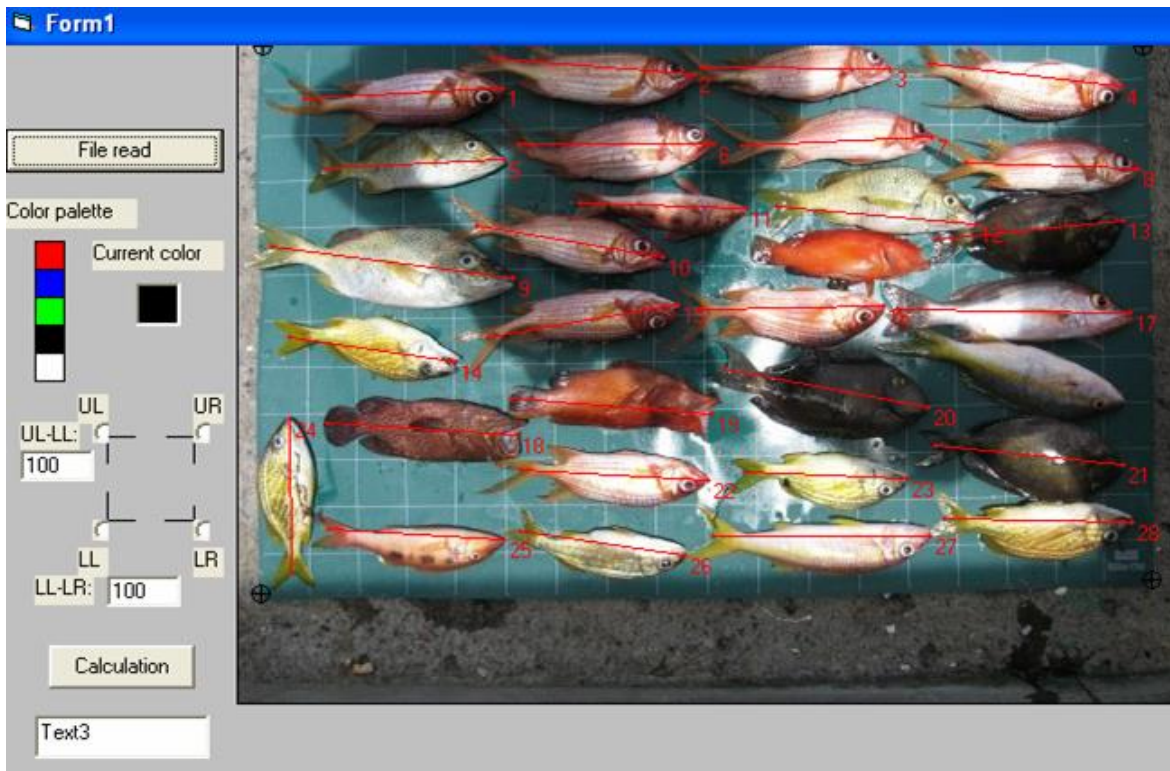


Figure 4: Measure the fishes with a special software display on a clean carpet.

### Results/Discussion

The phone surveys based on fishermen declaration give a good estimation of the number of fishing trips and landings. A comparison between phone surveys and port surveys results gives a difference of 11 % in the number of fishing trips estimates. Landings weighted by data collectors compared with fishermen declaration show an underestimation of the second one of 8 %, the day of the survey (n= 57 observations) and an overestimation of 5 %, 6 days after (n= 46 observations). The number of fishermen who can't be reached by phone (nearly all fishermen have at least one phone) and of refusals to answer, permanently or temporarily (9.6 % of total captains) was established.

The cost of investigations has been assessed. The average time for one call is 5 min., the average number of call for 15 inquiries is 29 and the number of positive call is 14. The time to capture the data (1 inquiry; 7 days) is 10 min. The main advantages of the telephone survey are to make random sampling easy and low data collection cost. The main disadvantages are the difficulties in obtaining a species composition for multi species fishing and to validate fishermen declaration.

The fast sampling method by photography has the advantage of enabling a traceability of species, which is useful for studies on species biodiversity and evolution according to environmental changes. The time on the field is divided by 4 and the fish's identification is possible in the lab by an expert (division of labour).

## SESSION 6

### Reducing risk in a high risk job.

Session lead: John LaFargue | NOAA/NMFS, USA  
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Observers encounter many hazards working on both commercial and recreational fishing boats. They encounter everything from poor vessel conditions and extreme weather to harassment and violence. This panel served as a way to identify hazards, identify what has been done to successfully mitigate hazards, identify remaining needs, and to identify strategies/ideas that can fulfill these needs.

## Panelists

### *THE ROLE OF RFMO OBSERVER PROGRAMS IN PROMOTING VESSEL SAFETY IN HIGH SEAS FISHERIES (AREAS BEYOND NATIONAL JURISDICTION)*

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Concerns have been raised about the safety of fishing vessels operating on the high seas following several serious incidents, including vessel sinkings with tragic loss of life. This presentation explores options for enhancing safety standards in international fisheries through specific measures in RFMO observer programmes. RFMO observer schemes represent one of the main interfaces between the RFMO Members and the active fisheries under their purview. With a large number of observers routinely deployed on vessels every year, there is an opportunity to collect detailed information on safety standards and safety incidents that would be invaluable in the effort to reduce the number of accidents. We explore the roles that RFMOs can reasonably expect observers to play, the objectives that the RFMOs might seek to deliver through them, and how this work could be incorporated within existing observer guidance, training and accreditation processes. We also review the current provisions in a range of observer programmes addressing safety issues through training, observer equipment and operational protocols. The Association of Professional Observers (APO) was contacted as an independent source of information, and various FAO documents, including the manual on observer programme operations, were examined. The project resulted in a range of recommendations including vessel inspections, safety checks by observers, best practice guidelines on observer training, recording of incidents and unsafe practices and sharing of information.

### *ESTABLISHMENT OF MONITORING UNDER PRECARIOUS CONDITIONS IN EXTREME AREAS: CHALLENGES FOR SCIENTIFIC OBSERVERS*



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In the XI region, located between 43° 38' and 49° 16' S and from 71° 06' W, the catch of Benthonic crustaceans has become an important activity within local and national fisheries, requiring monitoring to establish the dynamics of these resources and the fishing pressure. The sampling methodology implemented by the Fisheries Development Institute (IFOP), with great success in other projects is an



important tool. However the geographical characteristics (fragmentation of the land, emerging new islands) demonstrate that monitoring, is the product of a cascade of events such as, i) access to boarding, defined in meetings with managers who manage the fishing fleet, ii) selection of the sampling site (island), subject to the habitability of ships, transporting ships and iii) stay in the Monitoring zone, subordinated to the fishing zone outing arrangements and climatic conditions policies. The provision of fishing and biological information in the field is hampered by the size of ships, limited space available on board, low technology of fishing gear and poor working conditions, disadvantages which are resolved by the observer scientists thanks to their preparation technique. The final product of monitoring results in obtaining fishery data (landings, effort and fish yield, accompanying fauna, geo-referencing of fishing zones) and biologic (size structure, relationship in length-weight, sexual proportion, reproductive condition). The data and results generated by this monitoring are of great value as they are the first data that have been obtained in the area, being IFOP the only institution responsible for obtaining this information.

## OBSERVER SAFETY TRAINING ACROSS USA OBSERVER PROGRAMS



Bohem, S.  
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It is common for observers in the United States to work in different regions throughout their careers. Safety is an essential component to all national observer training programs (Northeast, Southeast, Alaska, Northwest, Southwest, and Pacific Islands). Each training needs to be tailored specifically to the fisheries they represent as every region presents its own unique safety challenges such as cold water, extended off shore trips or dangerous gear types. While the minimum safety training standards include 19 hours of safety training, some programs dedicate more time, require higher first aid certifications and/or require observers to take additional gear (i.e. first aid kits, satellite phones) on assignments. Mainly these differences are justified by the type and nature of the fishery and length of fishing trips.

An important factor in safety training is maintaining consistency among every region so that all observer trainings meet minimum standards. Those standards are created and overseen by the National Observer Program Advisory Team (NOPAT) Safety Committee. Inconsistencies do still exist in areas such as safety re-training timelines and level of first aid certification which could be standardized and improved on in the future.

## EXAMINING THE ITEMS THAT COMPOSE A VESSEL SAFETY CHECKLIST AND APPLICATIONS FOR INTERNATIONAL OBSERVER PROGRAMS.



Ivany, C.  
Alaskan Observers, USA.

### **Introduction**

To collect the quality data needed to help manage the world's fisheries and marine resources, at-sea observers must face many challenges and obstacles in one of the most dangerous of field occupations. Various measures are taken to help prepare for the at-sea experience and promote safety on the job. At-sea safety depends upon many things, one of those being the vessel's safety equipment. The West Coast Groundfish Observer Program (WCGOP) requires observers to perform a check of the vessel's safety equipment before deploying, in efforts to enhance the safety of observers at-sea. The Vessel Safety Checklist used by WCGOP addresses various items, some of which are deemed necessary for the deployment of the observer. The necessary items are based on laws described by the United States' Code of Federal Regulations for

commercial fishing vessels operating within the 200 mile Exclusive Economic Zone. In addition to those items are some suggested by observers to help address concerns not covered in the code of regulations. Observers are required to change vessels quite often. Completing a vessel safety checklist before initial deployment, and once per debriefing period, allows observers to discuss safety issues with vessel crew and helps to keep vessels operating within current regulations with valid equipment. Locating safety gear and inquiring about emergency procedures, unique to each individual vessel, enhances the observer's ability to deal with at-sea emergencies and be more prepared for their own personal safety.

The WCGOP safety checklist was created in collaboration with other observer programs and with the consideration of regional regulations. The content of the safety checklist continues to improve with annual updates based on suggestions from both observers and staff.

Observers and monitors face similar hazards all over the world and through the exchange of ideas we can better prepare each other for the dangers we face on commercial fishing vessels. Although each program must follow the rules and regulations of their government and Regional Fishery Management Organization with concern to safety equipment requirements, providing an example of how useful a safety checklist can be before an observer deploys, may help developing observer programs to create their own safety checklist as a tool to further the safety of observers everywhere.

There are many things that one can do to prepare for a safe and successful at-sea experience. From checking weather forecasts to vessel safety exams, safety begins before deployment. Weather conditions may not always be optimal and can complicate problems at sea. Because we can't control the weather, being prepared for dangerous situations and being familiar with the vessel, helps to increase your chances of success at sea. It all begins with scheduling a vessel safety inspection and completing the checklist.

### **Methods and Materials**

I would like to provide a copy of a completed Vessel Safety Checklist and explain the process of performing a vessel safety check. Hopefully at the end of such a discussion some will take our ideas home to implement in their programs and others may provide ways for us to further improve ours.

The vessel safety check begins with contacting the vessel owner/operator and scheduling an appointment. Always wear a Personal Flotation Device (PFD) when boarding/disembarking and while performing duties outside of the vessel house. Avoid boarding without a crew member present as this can also be a danger in certain situations.

These checklist items are not a comprehensive list of all possible safety concerns and you should use personal judgment as to whether a vessel is safe or not.

### **Results and Conclusions**

There is no doubt that training, safety drills, and vessel safety inspections, all increase your chances of survival at sea. Fatality rates have dropped by 20% nationally and by 50% in Alaska since the establishment in 1988 of the Commercial Fishing Industry Vessel Safety Act. In "Update on U.S. Commercial Fishing Industry Vessel Requirements", the Coast Guard notes that 2/3 of commercial fishing vessels lost to flooding are because of hull or equipment problems and that poor vessel maintenance is often a factor. Taking the time to complete a safety checklist will help you become more familiar with a vessel before you deploy. It may also bring to your attention items that need to be addressed before you can deploy. If unsure whether a vessel is safe or not, contact a coordinator or supervisor for advice.

The oceans across the globe provide a much needed resource and proper management helps to ensure that these marine resources are sustainable and renewable. The at-sea observer is an essential part of the management team, doing so in a challenging and sometimes dangerous work environment. The safety of these individuals should be a priority in all programs and together we can improve the at-sea experience through the discussion and exchange of ideas. The situation varies from program to program and what works in one may not in another. Local regulations need to be considered in the development of a vessel safety checklist and the items composing the list should be relevant to the fishery being observed.

# SESSION 7

## How to determine and reduce bias in monitoring programs?

Session lead: John Carlson | NOAA/NMFS, USA

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There can be many potential sources of bias in the collection and analysis of scientific data. This session discussed which are the main sources of sampling or analysis bias are and what procedures or methodologies can be employed to minimize them. Examples of potential sources of bias from observer programs include: vessel selection, catch sampling, changes in fishing behavior when an observer is or is not on board, and analysis techniques employed in the estimation of catch and bycatch.

### Panelists

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#### *TYPES OF BIASES THAT AFFECT MARINE MONITORING PROGRAMS AND PRACTICAL SOLUTIONS TO CONTROL BIAS.*

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Bias is an inclination to present or hold a partial perspective at the expense of (possibly equally valid) alternatives. Unfortunately, bias can play a major role in marine monitoring programs and can drastically skew the reliability of scientific data. There are many types of inherent biases pertaining to marine fisheries data collection and analysis. For example observers and other catch monitors may be biased in vessel selection due to such factors as vessel size, attitude of the captain and crew, as well as potential language barriers between monitors and crew. Once these sources of bias have been identified, we can implement procedures to reduce the effects of bias on data collection. Bias occurs because of thought processes that are often difficult to identify in marine fisheries monitoring programs. Mental and emotional factors that determine bias include information-processing shortcuts, motivational factors, and social influence. Information-processing shortcuts are experienced based techniques for problem solving which are used to speed up the process of finding a satisfactory solution. An educated guess, rule of thumb, and intuitive judgments are all examples of information processing shortcuts. Information-processing shortcuts can lead to inaccuracy in monitoring programs because decisions are based on past experiences. Motivational bias arises when an individual's needs interfere with their ability to collect accurate data. For example, motivational bias can cause a catch monitor to be more or less inclined to observe a particular vessel due to the duration of the trip. Social bias is the tendency of individuals to behave in a manner that will be viewed favorably by others. An example of social bias is a fisherman altering his fishing methods in an attempt to accommodate the catch monitor on board. Social bias in monitoring programs results in overemphasizing behaviors that are viewed as desirable while underemphasizing behaviors that are viewed as undesirable. All three of these types of biases occur in marine monitoring programs and can reduce objectivity throughout the chain of collection-debriefing analysis; e.g., during vessel selection, catch sampling and subsampling, species identification, and emergency situations. I discussed practical solutions the West Coast Groundfish Observer Program has implemented to reduce these forms of bias. Solutions include random sampling to reduce bias in catch sampling/subsampling, random vessel selection to reduce bias in vessel selection, the use of logbooks to reduce bias in debriefing, and annual safety drills to reduce bias in emergency situations. Bias occurs because of an individual's inability to be objective. With the implementation of protocols to counter these types of biases a marine monitoring program can operate at a level of optimal objectivity.

## DOES OBSERVER COVERAGE OF SPECIFIC VESSELS AFFECT BYCATCH ANALYSIS?



Carlson, J., Passerotti, M., Mathers, A., Gulak, S.

NOAA/NMFS USA.

### Introduction

Selection of fishing vessels for the purpose of carrying on-board scientific observers to collect catch, bycatch and fishing operations information is generally conducted using a randomized selection based on temporal and spatial strata. However, due to problems related to safety and enforcement, observer programs often select from a limited pool of vessels or are forced to cover the same vessel multiple times. This can create issues as captains of these vessels

may fish differently than the fleet as a whole, biasing any subsequent bycatch analysis. Vessel captain skill and ability plays a central role in the harvesting of fish but also on the capability to avoid protected species. Examining the influences of vessel captain ability on catch rates and bycatch avoidance may be complicated, since vessel captain ability is generally unobservable. Using data on historical activities in the shark gillnet fishery as an example, we examine the use of fixed and random-effects models to test for differences in bycatch rates that are hypothesized as representing differences in vessel captain efficiency.

### Methods

The shark drift gillnet fishery developed off the east coast of Florida and Georgia in the late 1980's<sup>1</sup>. Observer coverage of the Florida-Georgia shark gillnet fishery began in 1992, and has since documented the many changes to effort, gear characteristics, and target species the fishery has undergone following the implementation of multiple fisheries regulations. Currently, there are a total of 222 directed and 276 incidental shark permits issued to fishers in the US Atlantic and Gulf of Mexico, of which only a small portion use gillnet gear. Many gillnet fishers have now begun targeting coastal teleost species with varying types of gillnet gear. As such, the southeast gillnet observer program currently covers all anchored (sink, stab, set), strike, or drift gillnet fishing by vessels that fish from Florida to North Carolina and in the Gulf of Mexico year-round. Current protocols for selection of vessels for observer coverage and collection of data are found in Passerotti et al. (2010)<sup>2</sup>. A combined data set was developed based on observer programs from Trent *et al.* (1997)<sup>1</sup> and Passerotti *et al.* (2010) and references therein). We used generalized linear models to determine which factors influence the probability of catch a sea turtle on a fishing set. Because the majority of sets in which a sea turtle was captured involved the catch of only one animal, there was little information gained from modeling the number of animals caught. The factors that were expected to influence the capture of a sea turtle were location, season, size of gillnet, time of day the gear was set, and the vessel identification number. The presence or absence of a sea turtle being captured was modeled with a logit link generalized linear model with an assumed binomial distribution. Following Ortiz and Arocha (2004)<sup>3</sup>, factors most likely to influence abundance were evaluated in a forward stepwise fashion. Initially, a null model was run with no factors entered into the model. Models were then fit in a stepwise forward manner adding one independent variable at a time. Each factor was ranked from greatest to least reduction in deviance per degree of freedom when compared to the null model. The factor with the greatest reduction in deviance was then incorporated into the model providing the effect was significant at  $p < 0.05$  based on a Chi-Square test, and the deviance per degree of freedom was reduced by at least 1% from the less complex model. The process was continued until no factors met the criteria for incorporation into the final model.

<sup>1</sup> Trent, L., D.E. Parshley and J.K. Carlson. 1997. Catch and bycatch in the shark drift gillnet fishery off Georgia and east Florida. *Mar. Fish. Rev.* 59(1):19-28.

<sup>2</sup> Passerotti, M.S., J.K. Carlson, and S.J.B. Gulak. 2010. Catch and Bycatch in U.S. Southeast Gillnet Fisheries, 2009. NOAA Technical Memorandum NMFS-SEFSC-600. 20 p.

<sup>3</sup> Ortiz, M., and F. Arocha. 2004. Alternative error distribution models for standardization of catch rates of nontarget species from a pelagic longline fishery: billfish species in the Venezuelan tuna longline fishery. *Fisheries Research* 70:275-294.

## Results/Discussion

For the binomial model, the time of year the vessel fished (i.e. season), the length of time the gillnet was in the water (i.e. soak), and the vessel (i.e. vessel ID) were significant as main effects for the capture of a sea turtle. A significant interaction was also found in the time of year and the vessel. A post analysis to test whether any individual vessels interacted more than others with protected species found that one vessel had a significantly higher sea turtle catch-per-unit effort than all other vessels. An examination of observer notes on this vessel indicates the captain of this vessel was relatively inexperienced and fished differently than the remaining vessels in the fleet. These results suggest that vessel or captain's inexperience may bias subsequent analysis of bycatch estimates. While most observer programs do not record information relative to the captain or crew's experience or fishing technique, results from this study suggest this data should be incorporated into future data collection protocols.

## ESTIMATION AND CONSEQUENCES OF BIAS AND OVERDISPERSION RESULTING FROM DEPLOYMENT AND OBSERVER EFFECT



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Reliable estimation of catch characteristics (e.g., discards, fish sizes) using data from fishery observer surveys (i.e., when coverage is <100%) is contingent on having sampling that is representative of activities in the fishery. Unrepresentative selection of sampling units (e.g., fishing trips, hauls; a deployment effect) and changes in fishing behaviour in the presence of an observer (an observer effect) can lead to biased estimation of catch characteristics and incorrect estimates of their uncertainty.

The objectives of particular observer programs can determine the likelihood of deployment and observer effects occurring. For example, many observer programs worldwide have dual objectives of compliance/regulatory monitoring and deterrence on one hand, and scientific monitoring of catch characteristics on the other. Effectively achieving each of these objectives typically implies very different and likely conflicting sampling schemes, with consequences for reliable estimation. While the former objective is most effectively achieved by targeted deployment of observers to the vessels that are most likely to be in regulatory non-compliance, the latter objective is best achieved by some sort of representative sampling. Furthermore, the regulatory role of observers (e.g., concerning bycatch limits) can create incentives for harvester behaviors<sup>1</sup> that result in an observer effect, as there is a strong disincentive for exceeding regulatory limits in the presence of an observer.

Using the fisheries of the Gulf of St. Lawrence (Canada) as a case study, simple methods for quantifying deployment and observer effects are presented<sup>1</sup>. The observer program for the Gulf of St. Lawrence has the dual objectives noted above. We found evidence for deployment effects in the majority of fisheries examined. However, we also found that the introduction of a mandatory requirement for harvesters to signal their intention to go fishing several hours before their departure has allowed for better planning of observer deployments, resulting in a significant improvement in deployment randomness among fishing trips. Based on this experience, we recommend that structural changes to observer programs are most likely to succeed in diminishing deployment effects. These include improved deployment randomness using statistically rigorous protocols and enhanced planning abilities via pre-departure hail-outs, enhanced separation of trip type (enforcement vs. monitoring) in the data and the elimination of vessels that can't or don't accommodate observers from the population of inference.

We also found evidence for observer effect in both fixed and mobile gear groundfish fisheries in the Gulf for the landed amounts of the species targeted by the respective fisheries and incidentally captured species that are targets of other fisheries. Observer effects of this nature can realistically only be addressed via structural changes to observer programs that remove incentives for observer effects, create disincentives or remove opportunities. Four possible

<sup>1</sup> Benoît, H.P. 2013. Twenty years of annual landed and discarded catches of three southern Gulf of St. Lawrence skate species estimated under multiple sources of uncertainty. ICES J. Mar. Sci. 70: 554-563.

approaches were reviewed. First, an observer program could be designed to be strictly scientific (no incentive for observer effects), though this requires a high degree of trust and a dramatic change in program objectives. Second, a complete census of fishing activities could be undertaken (i.e., no opportunity for observer effects), though this could be prohibitively expensive. Third, electronic monitoring (EM) of all fishing activities could be employed, creating a monitoring effect even if only a subset of the recordings are actually reviewed (i.e., a disincentive for observer effects). However, numerous logistical constraints discussed at this conference and in the literature suggest that ongoing work is required before EM can be applied with confidence in all circumstances presently encountered by at-sea observers. Fourth, an adaptive observer deployment scheme, in which a fraction of deployments are targeted to vessels for which there is evidence of an observer effect, could be employed<sup>2</sup>, though implementation of such a program would be logistically difficult.

While the case study from the Gulf of St. Lawrence suggests that statistical inference using observer data is likely to be unreliable for catch characteristics of commercially important species, there is evidence that this may not be the case for some commercially unimportant species. For those commercially unimportant species for which there are no discard bans, there is little direct motivation for observer effects, and where the distribution of these species happens to be generally random with respect to actual deployments, catches may be estimated with little or no bias and proper precision. This was inferred by comparing annual recorded landings to landings predicted using retained catches reported by observers. For taxa such as skates (Rajidae), sculpins (Cottidae) and windowpane flounder (*Scophthalmus aquosus*) there is good concordance between estimated and observed landings, and the coverage rate of the estimated confidence intervals is decent, though not ideal<sup>3</sup>. Given that landings are generally reliably predicted using observer records of retained catch, we infer that total discard amounts for these commercially unimportant species should be equally reliably predicted using records of discarded catch. These examples serve to highlight how the combination of fishery regulations and observer program objectives can result in incentives for observer effects for some species (i.e., the commercially valuable ones) but not for others (commercially unimportant and not subject to discard restrictions).



Chile's traditional dance presented at the 7ifomc Banquet

<sup>2</sup> Benoît, H.P. 2013. Twenty years of annual landed and discarded catches of three southern Gulf of St. Lawrence skate species estimated under multiple sources of uncertainty. ICES J. Mar. Sci. 70: 554-563.

<sup>3</sup> Benoît, H.P. and Allard, J. 2009. Can the data from at-sea observer surveys be used to make general inferences about catch composition and discards? Can. J. Fish. Aquat. Sci. 66:2025-2039.

## *METHODS FOR ELIMINATING CATCH SAMPLING AND VESSEL FISHING BEHAVIOR BIAS IN THE GULF OF MEXICO AND SOUTHEASTERN ATLANTIC FISHERIES.*

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### **Introduction**

The U.S. Southeast Observer Program is responsible for placing fisheries observers on shrimp vessels and reef fish vessels operating in the U.S. Gulf of Mexico and southeastern Atlantic. The primary objectives of this program are to quantify species-specific fishery catch rates, including sea turtles, by area and season in these commercial fisheries and to evaluate the effectiveness of bycatch reduction devices and turtle excluder devices in the shrimp trawl fisheries<sup>1</sup>.

Outlined here are illustrations of catch sampling, vessel fishing behavior, and vessel selection bias, as they apply specifically to the U.S. Southeast Observer Program. Recognizing and reducing bias in all observer programs is a fundamental necessity, if observer data is to be trusted by fisheries managers as representative of the fisheries from which that data is collected.

### **Methods**

The method for collecting a species composition subsample for each tow in the Gulf of Mexico and southeastern Atlantic shrimp fleet in particular, is an example of a catch sampling technique that may benefit from a review of similar observer program catch sampling techniques. Presently, the standard practice for collecting a species composition subsample on Gulf of Mexico and southeastern Atlantic shrimp vessels is to mix the catch from the net or nets that have been selected to collect a subsample, using a shovel to ensure that it is evenly mixed. The target shrimp and bycatch species are often stratified in the net, so after the catch has been dumped on deck, mixing the catch is used as a means of reducing potential bias due to unrepresentative sampling<sup>1</sup>. This method can be haphazard because there is little assurance that every observer onboard these vessels will mix the catch evenly and sufficiently enough to eliminate any bias from each sample.

Two substantially sized fisheries in the Gulf of Mexico have until recently never been required to carry observers: the skimmer trawl fishery (comprising more than 2,000 permitted vessels<sup>2</sup>) and the Menhaden purse seine fishery (the largest fishery by volume of landings in the Gulf). In 2004 and 2005 observers were placed onboard three skimmer vessels on a voluntary basis. Then, in 2010 a sea turtle mass-stranding event raised concerns about potential sea turtle captures in the skimmer trawl fishery<sup>2</sup>. Subsequently, from May to August 2012, mandatory observer coverage was required for skimmer vessels fishing in the Gulf of Mexico. Observers onboard these vessels were responsible for collecting data related to interactions with threatened or endangered sea turtles as well as data quantifying target and non-target species per haul<sup>2</sup>. In the summer of 2011 observers were assigned to Menhaden vessels for 5-6 days at a time. On these vessels observers primarily collected estimates on bycatch species numbers per set and noted protected species interactions with fishing gear. These mostly unobserved fisheries are broad examples of: 1) Vessel fishing behavior bias: In a completely unobserved fishery there is no reliable way to account for at-sea discards of bycatch species or incidental takes of protected species; 2) Vessel selection bias: In a fishery with infrequent or irregular observer coverage, observer data is more likely to be non-representative of the fishery on the whole.

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<sup>1</sup> Unpublished manuscript. Southeast Observer Program Manual 2011. On file at NMFS Southeast Fisheries Science Center, Galveston Laboratory, 4700 Avenue U, Galveston, TX 77551.

<sup>2</sup> Pulver, J., E. Scott-Denton and J. Williams. 2012. Characterization of the U.S. Gulf of Mexico skimmer trawl fishery based on observer coverage. NOAA Technical Memorandum NMFS-SEFSC-636, 27 p.

## Results/Discussion

### *Catch Sampling Bias*

Individual observer program catch sampling techniques can and should be adjusted to reduce bias by adopting sampling techniques from other observer programs and tailoring them so that they are well-suited for the individual program, when it is deemed prudent to do so.

The Northeast Observer Program uses a technique for sampling a similarly stratified catch that is intended to ensure a random and representative composition sample<sup>3</sup>. This technique asks the observer to divide the catch into a mental grid and take fish equally from the top, middle, and bottom of the pile for the sample.

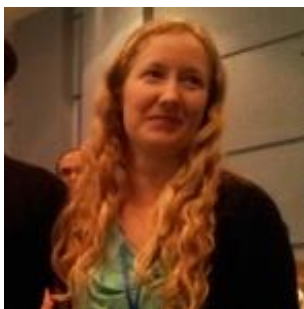
Simply put, every observer program could benefit from a thorough review of sampling techniques used by other programs where there are marked similarities in potential catch sampling biases. It should be noted that in order for the Northeast program technique to work if employed by the Southeast program, the size of the catch would have to be substantial enough to roughly designate a top, middle, and bottom (which would not always be the case). This technique may not be best-fit model for the Southeast Observer Program, but careful examination of other observer program sampling methods is a prospect worth considering.

### *Vessel Fishing Behavior Bias/Vessel Selection Bias*

Plans should be developed to deploy observers into previously unobserved or lightly observed fisheries such that observer data from those fisheries is less likely to be biased by modified vessel fishing behavior or non-representative deployment of observers.

The North Pacific Groundfish Observer Program published an Annual Deployment Plan in January 2013 stipulating that vessels fishing with hook-and-line or pot gear that are greater than or equal to 40 ft, but less than 57.5 ft in length overall would be subject to partial mandatory observer coverage<sup>4</sup>. These vessels will be picked at random for observer coverage, and notified approximately 60 days prior to a 2-month selection period. They would then be required to carry an observer for all trips made during that 2-month selection period.<sup>4</sup>

Until recently the vessels now subject to partial mandatory observer coverage by the 2013 Annual Deployment Plan had never before been required to carry observers. This plan would seem to obviate the potential for vessel fishing behavior bias, because there would be economic disincentive to adjust fishing practices dramatically when carrying an observer, if that observer is onboard for all trips made during a two month period. Furthermore, the randomized deployment strategy negates the possibility for observer data bias due to non-representative deployment. Applying a deployment plan such as this one to observer coverage in a previously unobserved or seldom observed fishery should help facilitate the collection of quality observer data, and reduce the likelihood of vessel fishing behavior and vessel selection biases.



REDUCING BIAS, PROTOCOL IN THE GULF OF MEXICO REEF FISHERY Hutton, S.

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### **Introduction**

Fisheries information collected by observers guides responsible management and conservation of living marine resources. Data of such importance needs to be of the highest quality possible. The Southeastern Fisheries Observer Program implemented

<sup>3</sup> Unpublished manuscript. Northeast Observer Program Manual 2010. On file at NMFS Northeast Fisheries Science Center, Fisheries Sampling Branch, 166 Water Street, Woods Hole, MA 02543.

<sup>4</sup> NOAA. 2013. 2013 Annual Deployment Plan for Observers in the Groundfish and Halibut Fisheries off Alaska. Fisheries Monitoring and Analysis Division, 7600 Sand Point Way NE, Seattle, WA 98115.



specific protocols to minimize bias while selecting boats and collecting data aboard reef fish vessels.

Mandatory observer coverage by NMFS began in July 2006 to characterize the commercial reef fishery operating in the U.S. Gulf of Mexico, per the Gulf of Mexico Fishery Management Council's (GMFMC) Reef Fish Fishery Management Plan. This fishery consists of approximately 890 federally permitted vessels, with a few primary gear types and target species. Bottom longline and vertical line (bandit and handline) keep many reef species but generally target groupers, *Epinephelus* spp., and snappers, *Lutjanus* spp., depending on gear configuration and depth of fishing. Longliners fishing shallow waters generally target red grouper, *Epinephelus morio*, while those in deeper water target yellowedge grouper, *E. flavolimbatus*, and tilefish (*Malacanthidae*). Vertical line vessels also target shallow-water grouper and red snapper, *Lutjanus campechanus*, but bandit boats with specific rigs may target vermilion snapper, *Rhomboplites aurorubens*, as well.

### Methods

Vessels required to take observers are randomly selected. The selection is stratified by season, gear, and region to ensure a proportional sampling effort. Effort data is updated annually and directs coverage levels toward region and gear strata with higher levels of fishing effort, while continuing to sample strata with lower fishing effort.

On board vessels, in addition to initial safety and vessel information, observers note gear configurations, location, depth, environmental parameters, species interactions, and fishing time for each sampled set. Fishery data obtained includes the length, weight, condition when captured, and fate of each fish. Observers also record if venting occurred for each fish, and only vent fish themselves by request in the same manner as the crew has demonstrated.

### Results/Discussion

To prevent vessels from shortening trips when observers are aboard, a minimum sea day requirement by gear type was established. Permit holders are required to carry an observer for at least 7 days during a selection period when using longline gear, 3 days for bandit gear, and 2 days for handline.

Sampling on longline vessels involves keeping track of how many hooks are set out during each haul and collecting data on every fish that comes aboard. Vertical line sampling becomes more complex because the different gear configurations require additional data. Each reel is numbered and the number of hooks is recorded along with the number of times each reel is dropped for each location and reel. If there are too many reels to keep up with, a subsample of reels is chosen using a random table to prevent favoring certain reels. The numbers of hooks fished for the unsampled reels are also recorded so species numbers can be extrapolated for the set.

With all gear types, a number of situations may interfere with an observer's ability to collect all desired data. Observers must prioritize data to collect all information necessary to calculate catch per unit effort (CPUE). CPUE is calculated by hook hours fished, so fishing time and the amount of hooks fished are the highest priority data. If a set cannot be sampled at all due to weather or other reasons, the minimum effort of fishing time, location, and depth are recorded. If time is a limiting factor, weights may be not obtained due to a flexible set of data priorities for the observer. Discarded captures need to be processed quickly to prevent effecting mortality rates, so if a large number of undersized fish are on deck waiting to be measured, observers may return them to water without obtaining weights and sometimes lengths. To be considered a sampled set at least the amount of kept and discarded species needs to be recorded. Minimum sea day requirements were established to prevent some observer effect, but other influences are still undetermined. Observers are instructed only to vent discarded fish if it is normally practiced on board and in the manner that it is normally practiced. However, observers may more consistently vent, thus artificially decreasing mortality rates. Video monitoring may be able to help determine if venting differences affect data results by comparing mortality rates between vessels with and without observers and noting venting practices on the video. Fishermen who are unsure about an observer's role on board and suspect enforcement may refrain from retaining some species and sizes for sale or bait. While these differences are unavoidable, clear communication with the fishermen may reduce them. The Southeastern Observer Program has recognized potential sources of bias and implemented protocol to eliminate or reduce them, but observers must also work individually to mitigate bias where they see it and gather the most complete and accurate data possible.

## A PROTOCOL FOR DATA EXPLORATION TO RAPIDLY IDENTIFY BIAS IN AT-SEA OBSERVER OR SELF-SAMPLING PROGRAMS

Uhlman, S.

IMARES, Netherland.

To detect and subsequently minimize bias, this study investigates the utility of simple and universally-applicable quality indicators for two at-sea sampling techniques of Dutch demersal beam trawlers. We compared measures of proportionality of sampling on temporal, spatial and biological (i.e. catch composition) scales to evaluate how well observed trawls, trips and vessels represent their respective total populations. Between 2009 and 2011, vessels were sampled independently by using either observer-based or self-sampling techniques on different trips. Compared with self-sampling, observer sampling clustered in the Southern North Sea. During both observer- and self-sampled trips, sampling frequency was low at night, and on certain weekdays. Observers tended to overestimate total catch volumes, and seemed to underestimate numbers of benthic invertebrate discards. Using this protocol as a template to identify and reduce bias in at-sea monitoring schemes will be a useful tool to eventually improve the accuracy of observations.

## SIMULATING THE IMPACTS OF ALTERNATIVE OBSERVER DEPLOYMENTS IN ALASKA



Faunce, C.

NOAA/ NMFS, USA.

In 2011, the commercial fisheries of Alaska accounted for over half of the U.S. domestic landings of fish and shellfish. To ensure that this harvest is at or below scientifically based levels prescribed by stock-assessors, the Alaska Regional Office employs a variety of regulatory tools. The sustainable harvest and effective management of Alaska groundfish is supported by one of the largest observer programs in the world. However, the program suffers from the fact that fishers have control over which fishing trips carry observers. The resulting haphazard monitoring of the fisheries has the potential to introduce biases to the catch estimation process. Obtaining control over where and when observers are deployed into the Alaskan groundfish fleet has been a focus of the National Marine Fisheries Service since 1992. In 2010, the North Pacific Fishery Management Council voted to restructure the observer program to include vessels fishing for Pacific halibut and to transfer deployment authority to the NMFS. With this authority, the NMFS was required to generate an Annual Deployment Plan (ADP) to guide the implementation of the new program in 2013. This requirement necessitated the generation of sampling and deployment strata, determination of a deployment rate that could be afforded by the program budget, and a comparison of the amount of coverage that would be expected from the new deployment to deployment under status quo. This presentation briefly explains how simulation of randomized observer deployment from 2011 landings data was used to derive these elements of the 2013 ADP.

## SESSION 8

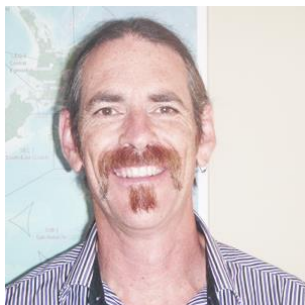
### Fisheries enforcement role in compliance with international treaties relative to resource sustainability

Session lead: John Choinard | Fisheries and Oceans, Canada  
E-mail: John.Chouinard@dfo-mpo.gc.ca

The intent of this session was to understand how law enforcement professionals use observer data to enforce laws that conserve and protect our living marine resources, their natural habitat, and the individuals that collect data for these efforts. The session will also explore how ship owners, crew members, and industry stakeholders perceive the use of observer data by law enforcement. In addition to discovering what resources law enforcement organizations can offer observers.

## Panelists

### COMPLIANCE USE OF OBSERVER DATA



France, A.

Ministry for Primary Industries, New Zealand.

Monitoring and auditing the behaviour of vessels processing at sea is challenging in the absence of direct surveillance. Inferring behaviour from data analysis is often the only feasible option. Profiling of deep-water fisheries can be undertaken using a number of analytical methods, ranging from comparing relatively simple indices derived from the data to sophisticated statistical modeling.

Data from observed fishing trips has been a vital component of this profiling. There is substantial evidence that vessels with government observers aboard tend to report accurately, while those without frequently do not. Observed catch data from the Ministry for Primary Industries (MPI) observer trips thus provides a standard against which reported catch from unobserved trips can be assessed.

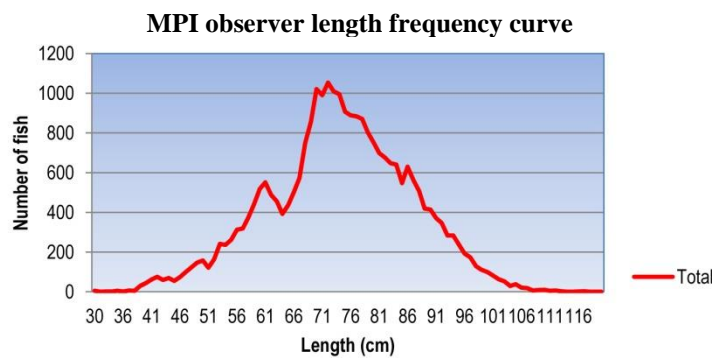
The deliberate discarding of smaller, damaged or less valuable fish to maximise economic return is referred to worldwide as highgrading. In theory highgrading is most likely to occur in fisheries where:

- There is a wide price difference between large and small fish; and
- The proportion of large fish expected in future catches is high; and
- The cost of additional fishing effort is low; and
- The fishery is managed under a system of individual limits on landings.

The fishery that the Ministry for Primary Industries (MPI) Compliance group profiled exhibits all four of these characteristics. That fishery was the New Zealand fishery for hoki (*Macruronus novaezelandiae*). The fishery for hoki is both the largest and the most valuable fishery in New Zealand waters. The hoki fishery has undergone significant reductions and changes in its Total Allowable Commercial Catch (TACC) levels since 2000. In 2000-01 the TACC for hoki was set at 250,000 tonnes. TACC reductions were made over subsequent years because the hoki fishery was estimated to be below management target fishing levels. In 2010-11 the hoki TACC was set at 120,000

tonnes increasing by 10,000 from the previous year. Because the hoki fishery is a high volume and a high value fishery it has continued to have significant commercial importance despite the reductions in the hoki TACC.

In order to confirm the existence of and identify the extent of highgrading in the hoki fishery, a length-based analysis was carried out, for which MPI observer data was the critical component. Observers at sea measured over 25,000 fish which enabled a length frequency curve to be constructed for the fishery.



In the absence of highgrading one would expect the length frequency of the landings to approximate the length frequency of the fish seen by the observers. To ascertain the length frequency of the landings, MPI Fisheries Officers (Compliance staff) were tasked with collecting various information types.

Fishery Officers conducted both at-sea and in-port inspections and gathered information specific to vessels operating in the fishery, including:

- Obtaining copies of vessel processing specifications for hoki processed by state and grade;
- Establishing what hoki ‘green block’ contained (small and/or damaged hoki);
- Obtaining copies of vessel unload manifests for the trip recording hoki by state, grade, number of units and weight;
- Conducting carton checks of a random sample of hoki from each state and grade to determine number of fish (where applicable) per block and size differential;
- Where possible establish minimum processing sizes for hoki, i.e. green block, meal etc.

Fishery Officers undertaking this work conducted 43 comprehensive in-port inspections and boarded 20 vessels at sea. During the in-port inspections Fishery Officers examined and weighed approximately 32.5t of hoki and 48t of bycatch species. During the at-sea inspections Fishery Officers examined and weighed approximately 3 t of hoki and 1 t of bycatch species.

The results of the length-based analysis found that the landings of the foreign chartered limited processing factory vessels (LPFVs) contained a smaller proportion of small hoki than expected as calculated from observer length frequency data. It was estimated that the LPFVs may have omitted to report about 30% of the small hoki that they caught. Filleting vessels produce ungraded products (e.g. Fillet block), so a length-based analysis of landings was not possible. However all of the fillet vessels have meal plants and any small hoki not wanted for other processing will be converted to fish meal. The amount of fish meal produced from offal as recorded on unload manifests was compared with the amount of offal available as a by-product of processing. The filleting vessels’ production of fishmeal from offal was found to be too high. One of the possible causes of this was due to whole fish to meal not being reported accurately.

Analysis was also undertaken to compare MPI observer catch records with the catch records reported by the vessels, specifically focused on by-catch quota species. In practice the comparison is rather complicated since

- i. the vessels make a comprehensive report of catch only once per day, rather than tow by tow; and
- ii. the catch reported by vessels on their Catch Landing Returns is often greater than the sum of their Trawl Catch Effort Processing Returns.

The catch data needed to be groomed and stratified for comparison with MPI observer catch data. For many species, there was a variation between what the MPI observers recorded as being caught and what the fleet as a whole reported. The differences applied to both quota species and non-quota species. Again, observer data was critical for undertaking this analytical work.

In summary, MPI observer data has been a vital component of the Compliance Group's profiling work.

MPI Compliance Group has presented their findings to the Fishing Industry and will be working with them to address the areas of non-compliance. There will be more profiles undertaken of the deep-water fisheries by the MPI Compliance Group and there is an expectation that there will be improvement in the rate of compliance.

There has been no impact on observers' treatment or safety following Compliance's use of observer data. Observer data can be effectively used by Compliance for enforcing laws that conserve and protect the living marine resources and to encourage more compliant behaviour by the Fishing Industry. This can be achieved without any detrimental impact upon the observers undertaking their role.

### *THE EVIDENTARY VALUE OF OBSERVER PROGRAMS IN PROSECUTING OFFENCES.*

Hawes, K.

Ministry for Primary Industries, New Zealand.

The use of the observer programs can have a dual role of ensuring compliance with fisheries laws, but can also be used to provide evidence in support of any prosecution for fisheries violations. The evidence collected by the observer is only useful to a prosecution if it is admitted into evidence by the Court. It is this process which has a number of hurdles for the use of observers as prosecution witnesses. Observer-related cases are often difficult and time consuming to prosecute, and may be further complicated by the fact that, because there is a high turnover rate in some programs, it may be hard to locate the observer once a case goes to court. The credibility of observer data is often an issue during the enforcement process, and defense lawyers may attempt to cast doubt on an observers' professionalism during prosecutions. Observer programs that employ standardized protocols for recording and handling compliance related issues are, therefore, more successful in providing admissible evidence. Given these challenges, it is important for programs to develop mechanisms to support and protect observers so that they can carry out their duties and, when necessary, be available to act as witnesses.

### *PROGRAM INTEGRITY: MECHANISMS TO ENSURE THE INTEGRITY OF THE CANADIAN OBSERVER*



Slaney, L.

Fisheries and Oceans, Canada.

Canada's representatives provided a presentation on its two primary Observer Programs. The presenters emphasised why the independence/arm's length of the collector and the accuracy/reliability of the data is fundamental to the integrity of these programs. Canada's objectives for the observer programs include the provision of accurate information for fisheries management and providing reliable technical

and/or biological information in support of experimental, developmental, exploratory and commercial fisheries. The confidence in observer frameworks is compromised when the integrity of the observer program is undermined; resulting in compliance concerns and failure to provide reliable information undermines the confidence in the fisheries management planning processes and ultimately the assessment of stocks. To illustrate the current situation, Canada outlined an example of where a fishery officer had detected several examples of collusion, falsification and illegal reporting of data or information. It was stressed how serious this was viewed by Canada and the impact this activity has upon the fundamental objectives and outcomes of the observer programs.

Canada outlined further its three primary categories of concern for the respective observer programs; collusion, inaccurate data recording and complacency. 1. COLLUSION: the observer works in concert with the fish harvester to falsely report or represent the area of capture, species, weight, size, and quantity of discards. 2. INACCURATE DATA RECORDING: Deliberately mis-recording the area of capture, discards, catch composition and amounts seriously undermining the fundamental objectives of observer programs, stock assessment and catch/unit of effort. 3. COMPLACENCY: Observer fails to adhere to duties (e.g. infrequent monitoring of catch, sampling protocols, lack of verifying areas of capture, lack of quantity of discards, using third party information). Canada outlined some indicators of irregularities that fishery officers and fishery analysts use to determine if integrity concerns exist. Canada concluded its presentation by outlining the way forward for observer programs. Canada will be developing a comprehensive audit process that considers risk factors as well as the use of systematic spot audits that will enable a degree of confidence in the effectiveness of the regime.

One question asked by an At-Sea Observer (ASO) from Chile was, how Canada determined the illegal activity was occurring? Lloyd Slaney, delegate for Canada, provided examples of how Canadian Fishery Officers carry out surveillance, audits, inspections and investigations of suspected violations. Mr. Slaney also explained how different tools, techniques and devices are used to gather information in aid of determining if breaches of Canada's legislation have occurred. A second question was asked if Canada believed the ASO Program will have less integrity under the new restructured approach. Mr. Slaney informed those in attendance that the observers are typically a group of people with very high integrity and that despite the fact that we have identified some issues Canada believes the ASO Program is a good program and will continue to be a valuable program in the future. A third question was asked by a Canadian Observer about why Canada is inconsistent in advising at-sea observers on result of occurrences they report. John Chouinard, delegate for Canada, advised that there are times when we have not communicated well on this issue and it is an area we are hoping to improve upon in the future.

## *IMPACT OF REGULATION ON SCIENTIFIC OBSERVER'S DATA COLLECTION IN FISHERIES DEVELOPMENT INSTITUTE – CHILE*

Vera, C., Troncoso, M., Guzmán, O.

Instituto de fomento pesquero, Chile.

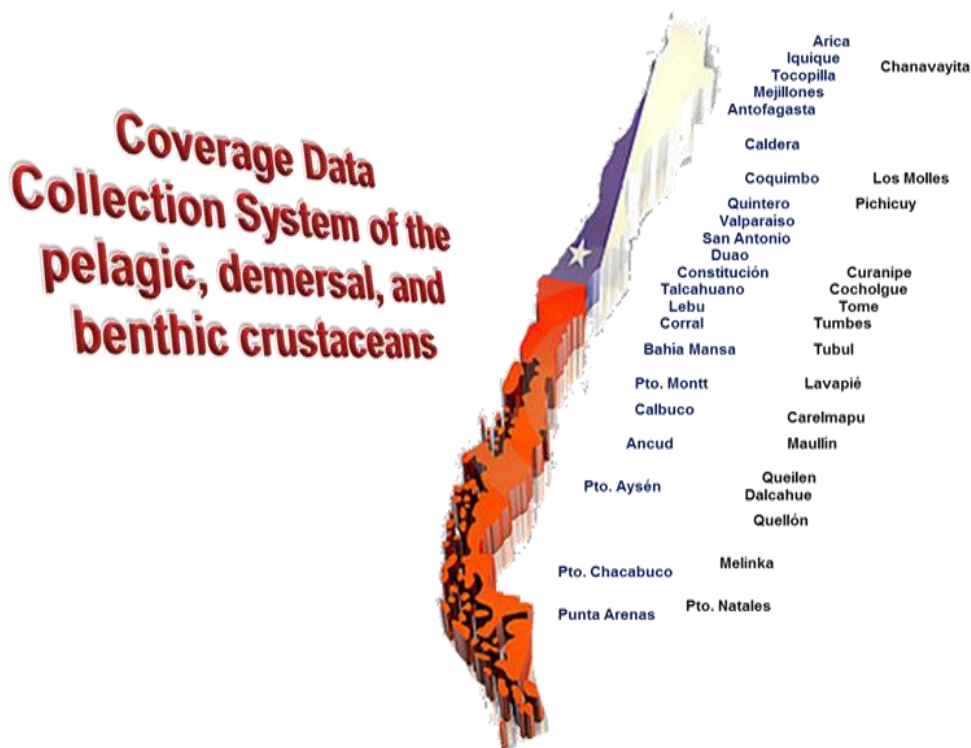
### **Introduction**

The Scientific Observer Regulation (ROC) became effective in 2006, by Supreme Decree 308 of the Ministry of Economy and Reconstruction, Undersecretary of Fisheries and Fisheries Development Institute began developing the Quality Management System (SGC) under Rule Quality ISO 9001/2000.

In this paper, we present the cause-effects of the implementation of this regulation, in the collection of data in terms of access, quantity and quality, and the changes involved in the training of scientific observers (knowledge and competency).

### **Results**

The Fisheries Development Institute (IFOP) for over 40 years has been monitoring the country's main industrial fisheries (Pelagic, Demersal and Benthic), both artisanal and industrial. This monitoring has been carried out in the main ports and inlets of each of the regions.



During 2006, entered into force on regulation Scientific Observers (ROC) (DS N ° 308 of the Ministry of Economy and Reconstruction) and began the development of the Management System (SGC), being certified in 2008 under the Quality Standard ISO 9001/2000, and upgraded to ISO 9001/2008 in November 2010.

Both Scientific Observer Regulation (ROC) and the Management System (SGC) facilitated the operation and control of the data collection system of the IFOP.

Some of the major advances in data collection:

- Allows system regulating biological data collection on fishing.
- Establishes obligations for owners and managers of plants, in relation to the Scientific Observers, regarding shipments and access to processing plants.
- Establishes the requirements, rights and obligations of Scientific Observers.

Moreover, in September 2012 the ROC became part of the Discard Act, extending this regulation to artisanal fishing.

The application of the ROC and SGC had significant impacts on data collection IFOP.

**a)** Before application of the ROC and SGC, the characteristics of the data collection were:

There was no obligation on the owners or managers of fish processing plants to require access onboard OC or processing plants.

The data collection depended on good interpersonal relationships, mainly from the OC with different fishing vessel owners or managers of processing plants.

There were no medical tests to see if his health was compatible with the activity on board.

The training was not standardized and was performed by the most qualified OC at the workplace.

There was no formal data requirement for data collection.

Each fishery had its own forms for recording data.

**b)** With the application of ROC and SGC, the characteristics of the data collection are:

- Mandatory fishing ship-owners or managers of processing plants provide access onboard OC or enter processing plants.
- Competencies were defined for Scientific Observer (Title of a Technical career, tied with marine science or some technical training center).
- Medical examinations are conducted for compatibility with the office.
- Standardized Training OC, such as: getting on board; arts and fishing gear; instrumentation on board, fishing regulations, sampling techniques, descriptive statistics, Identification of fish, birds, mammals, reptiles.
- Requirements were formalized for a project data plan, improved control and monitoring, standardized data collection, online data transmission, fingering by the OC, monthly reports quantity, geographical coverage and timeliness of data.
- Use of standardized and formalized data forms, by order of the Undersecretary of Fisheries (SUBPESCA).

In conclusion, the Fisheries Development Institute (IFOP), during its long career, in monitoring Industrial and Artisanal Fisheries, the data collection process has always been effective.

With the implementation of the Regulation of Scientific Observers (ROC) and Management System (SGC), the following progress was achieved:

- Efficiency was improved significantly in collecting data, maintaining its effectiveness.
- Administration was optimized with respect to the OC fleet operation.
- Improved process control collection.
- Begin data transmission online.
- Improved training programs for OC.

## IMPLEMENTATION OF THE DISCARDS AT SEA LAW IN CHILE



Cocas, L.

Undersecretariat for Fisheries and Aquaculture, Chile.

### Introduction

Over 7 million metric tons, equivalent to 10% of the world's marine catch, are discarded annually<sup>1</sup>. These levels of fishing mortality as a result of bycatch and discards, represent a major threat to the long-term sustainability of many fisheries around the globe and for the maintenance of biodiversity in many areas, resulting in increased food insecurity and adversely affecting the livelihood of millions of people depending on fishing resources<sup>2</sup>.

This condition can yet be more critical considering that such estimate could reach triple, depending on the discard definition used, and the inclusion of the unknown quantities from illegal and/or unreported fishing. Aware of this problem, and motivated by the need of its handling in order to advance in the recovery of the troubled national fisheries, the Chilean government enacted in September 2012, the Discard Law N° 20.625.

### Results and Discussion

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<sup>1</sup> Kelleher, K. 2005. Discards in the World's Marine Fisheries. An Update. FAO fisheries technical paper 470. Food and Agriculture Organization of the United Nations. 147 pp. Rome, 2005

<sup>2</sup> Food and Agriculture Organization of the United Nations. 2011. International Guidelines on Bycatch Management and Reduction of Discards. 86 pp. Rome, 2011



The law 20.625 amended the General Law for Fisheries; defining and regulating discards and incidental catches at sea, and also establishing control measures and sanctions for those who engage in such practice during their fishing operations. Sanctions for infringing the discard law will be applied to skippers and vessel owners, and will include both the artisanal and the industrial fleet.

Additionally, recognizing that the best fishing information for management is gathered by fisheries observers deployed on board commercial vessels during their normal operations, and considering that on-board observer reports are indispensable for accurate estimations of discards, this law incorporated significant changes, requiring vessels to provide infrastructure (sampling station), accommodations and safe working conditions for observers as well as a working environment free from harassment and interference that ensures the collection of unbiased data. The law also included penalties for who interferes with observer's tasks as well as the obligatory supplying of personal locator beacons (PLB) to the observers by the provider. These can be used by the observer when his physical integrity is threatened at sea. From now on, the Maritime Authority will not allow setting sail on those vessels designated to carry an observer for a period of time, if the observer is not aboard before departure.

According to the law, the Undersecretariat of Fisheries and Aquaculture (SUBPESCA), the government institution in charge of establishing regulations and policies for the fishing sector, shall approve for various target species and its bycatch, a Research Program for both the industrial and artisanal fleets, intended to collect technical data on discards and incidental catches (seabirds, turtles, and marine mammals). The program will last not less than two years and should at least include characterization, quantification and determination of discards in every monitored fishery, identification of causes of discard, and at least shall consider the information gathered by the observers onboard. The program's results shall include a list of measures intended to reduce discards of both target species and its bycatch. The information gathered by observers during the research program, with vessel and their owners names codified, will be public and may be required by any institution or NGO, to be evaluated and to propose additional mitigation measures on discards.

With the aim of discouraging any atypical behavior of the fishing fleets during their operations and to obtain unbiased data on discards, during the research program, sanctions on discards will not be applied to all participating vessels. Such participation will be materialized through both the random embarking of observers and through logbooks filled by the skippers in all trips (regardless of the presence of an observer). The latter represents a shift in the approach to the problem, allowing the fishing users to be responsible for the collection of information that will be used to find a solution. Within a maximum of three years of implementation of the research program and based on the information gathered, SUBPESCA shall establish a Reduction Plan for discards of target species and its bycatch and also for incidental catches. This Plan shall contain: a) management and conservation measures, and the technological means to reduce discards, b) a Surveillance, Control, and Vigilance Program, c) assessment of mitigation measures, d) a Training and Diffusion Program, e) a code of conduct for good fishing practices, and f) it may also consider providing incentives for innovation in gear selectivity.

Once fully implemented, the law will not allow discards at sea of target species and its bycatch, except when the following requirements are met: i) sufficient background information has been collected under the Program, ii) the Program keeps running, iii) an annual catch quota has been established for target species, iv) the quota has included discards, v) both, the target species and its bycatch are subjected to a Reduction Plan, and vi) discards does not affect the conservation of the target species.

Additionally, it will be mandatory for the safe release of marine mammals, turtles, and seabirds caught by fishing gears, unless they are severely injured. In such cases they shall be kept on board and brought to rehabilitation centers for aquatic species. The discard of some species will be also mandatory as required by specific administrative measures. Through resolution, the SUBPESCA will establish the list of species subjected to the requirements in this paragraph.

Additionally, all vessel owners shall record any discards as required by law, and also will be responsible for installing and maintaining a functioning electronic monitoring system (EMS) on board, running during their entire fishing trips, intended to detect and record any discard that may occur. This requirement is applicable for any vessel longer than 45 ft. long.

The National Fisheries Service (SERNAPESCA) or control agency, will require the information recorded by the EMS, and the image analysis will be performed either directly by the SERNAPESCA or commissioned to certified external entities. In the later case, the costs will be paid by vessel owners. The form, conditions, and application requirements of the EMS, as well as the safeguards to prevent its manipulation and interference, shall be determined by a regulation currently being written (due date, September 2014). This regulation will make distinctions between fisheries, type of vessels and fishing gears. The SERNAPESCA will monitor directly or through external entities the compliance with the requirements of the EMS regulation.

In accordance with Chilean Law 20.825, the images recorded by the EMS will be confidential, and its destruction, theft or improper disclosure will be punished.

The information generated by the EMS, and certified by Sernapesca, will be publicly available and also will constitute a presumption to prove violation of fishing regulations. The EMS on board, and particularly this last provision is extremely relevant to achieve the law's goals, since Chilean observers have no power or jurisdiction to monitor compliance with fisheries measures nor can act as ministers of faith, being relegated only to the collection of biological and fisheries information for management.

Consequently, in early 2013 SUBPESCA elaborated the respective technical reports, through which five bottom-trawl fisheries were selected, thereby initiating the Discard Research Program required by Law. These fisheries were considered priority due to the low selectivity of the gear used and because there was previous information indicating the frequent discard of specimens due to commercial (without market or under sized) or regulatory reasons. The fisheries selected were: 2 species of hake (*Merluccius gayi gayi* and *Macruronus magellanicus*), 1 species of shrimp (*Heterocarpus reedi*), and 2 species of crawshrimp (*Cervimunida johni* and *Pleuroncodes monodon*). Except for *Merluccius gayi gayi*, which included artisanal and industrial fleets, all the other covered only the industrial fleets.

Since discard has been forbidden in the past with severe sanctions, it became a taboo topic within fishermen, never afforded systematically in fisheries management in Chile. Therefore prior to beginning the data collection on board and in order to win the confidence of fishermen, it was considered indispensable to hold meetings and workshops in the field to socialize and sensitize the new law within fishery users, and also to educate them about the discard problem and the need to improve fishing practices and selectivity to ensure sustainability. During some of these workshops, SUBPESCA was assisted by international experts who presented their experiences on bycatch mitigation. In addition, during the workshops the sampling methodologies were explained, to reach a consensus regarding its implementation in a way that would have the least interference with fishing operations.

In an early stage it was noticed that studying, and mitigating discard it was going to be a highly complex task that requires the full involvement and consensus of fishing users. On the other hand, the industry showed big expectations on the mitigation measures that will be put into practice. Consequently with that scenario, SUBPESCA asked for a considerable increase in budget for 2014 to the Central Government, in order to improve the observer coverage, to include more fisheries and its entire fleets (artisanal and industrial), and to obtain unquestionable data to support its management and conservation measures involving discards.

Additionally, studying discards is a major challenge for Chile since fishing activity is huge. In fact Chile is among the largest fish producing countries on the globe, ranked sixth after China, Peru, the United States, Indonesia and Japan. Therefore the national fishing fleet is very large; particularly the artisanal fleets where there are thousands of vessels, some of them unregistered.

Nevertheless the constraints, the Program is currently being implemented by the Fisheries Development Institute (IFOP), and as of September 2013 is progressing well, with broad participation and collaboration of fishermen, forecasting good results.

## SESSION 9

### What are the future trends of transshipment observer programs?

Session lead: Teresa Turk | NOAA/NMFS Affiliate, USA

E-mail: Teresa.Turk@noaa.gov

The increasing transshipment operation is global in nature and creates expensive and logistically challenging situations, especially when replacing observers due to crossing into RFMO jurisdictions. Are those programs producing high quality data for efficient management?

### Panelists

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#### *STATUS AND TRENDS OF THE TUNA RFMO TRANSSHIPMENT OBSERVER PROGRAMMES*

Nugent, P., Moir-Clark, J.

MRAG Ltd., USA.

MRAG Ltd., Capfish and MRAG Americas Inc. currently operate transshipment observer programmes for ICCAT, IOTC, IATTC and CCSBT. The ICCAT programme was established first in 2007, followed by IOTC and IATTC in 2009 and CCSBT in 2010. All were introduced to monitor transshipment operations between carrier vessels and Large Scale Tuna Longline Vessels (LSTLVs) on the high seas. The programmes all collect generic data: name of the vessels transshipping, location of transshipment and amount transshipped by species. Further to this, the IOTC programme requires observers to check the LSTLV's licence, logbook, VMS and catches on board. All transshipments of southern bluefin tuna (SBT) are reported to CCSBT which requires verification of catch monitoring forms (CMFs), recording the tag numbers of the transshipped fish as well as the standard data collection. SBT transshipments can occur within ICCAT or IOTC waters and monitoring is run concurrently with those programmes. For all programmes photographs are taken of all the vessels to facilitate verification of identification. Standard data are collected by the observers from direct observations onboard the carrier vessel and cross checked against the transshipment declarations (TDs) produced by the LSTLV and the carrier vessel. Reporting is conducted at sea during deployments by the observers and in more detail at the end of the trip. If conditions are considered safe by the Master of the carrier vessel and the observer, additional checks of the LSTLV required by the IOTC programme are made by the observer transferring to the fishing vessel. Outputs from observer reports are sent to the concerned Member States to allow them to follow up on any queries, if appropriate. An annual report is also submitted to the Compliance Committee. There has been a high degree of integration possible between the ICCAT, IOTC, IATTC and CCSBT programmes: Training materials are shared and observers trained for ICCAT, IOTC and/or CCSBT will be certified for all three programmes. Vessels crossing over between ICCAT and IOTC are able to keep the same observer, reducing observer deployment costs. Transits between IATTC and ICCAT have happened rarely due to vessel schedules and the need for cross certification is therefore less. Potential future developments are greater integration between RFMOs by the inclusion of IATTC and WCPFC in the cross training and certification process to develop a global supply of transshipment observers. Compilation of a global vessel photograph library for LSTLVs could be a useful tool against transshipments by IUU LSTLVs in conjunction with a global vessel registry.

## SHARK CONSERVATION TRENDS IN THE PACIFIC AND THEIR EFFECTS ON THE IATTC TRANSHIPMENT OBSERVER PROGRAM

Belay, B., Moir-Clark, J.

MRAG Americas, IATTC.

MRAG Americas Inc. currently operates the transshipment observer program for IATTC. The IATTC program was established first in 2009. The Program was introduced to monitor transshipment operations between carrier vessels and Large Scale Tuna Longline Vessels (LSTLVs) on the high seas. In recent years the concerns with the bycatch of sharks by the LSTLVs have prompted several Pacific nations to levy heavy fines for transshipment of sharks in their waters. In July 2012, IATTC amended its transshipment regulations, elevating sharks to the same status as tuna and tuna like species. Resolution C-12-07 prohibits transshipment of tuna and tuna-like species and sharks caught by fishing vessels other than LSTLVs. Only LSTLVs that are included in the IATTC list of authorized longline vessels and that operate under the jurisdiction of CPCs that participate in the transshipment observer program are authorized to make transshipments at sea (now including sharks). In mid-August observers started reporting shark as well as bigeye (BET), yellowfin (YFT), swordfish (SWO), and other species (OTH). Previously sharks were recorded under OTH. Starting 8/15 observers began to identify sharks to species level and report numbers transshipped. Carrier vessels are required to report sharks and shark products on transshipment declarations to species. In addition, MRAG and IATTC are creating a policy on reporting species of shark when transshipped in product form such as fins. Shark products are often varied and identifying individual species may not be possible when product is in the final stage. This action by IATTC reflects a trend across the Pacific of more stringent protection of sharks. This presentation summarizes the shark conservation regulations recently enacted in the Pacific region and the effects they have had on the IATTC Transshipment observer program. We highlight resultant changes to the program, the role observers contribute effects on deployment logistics and provide some insight into future trends in shark management in the region.

## (DIS)HARMONY AMONG TUNA TRANSHIPMENT OBSERVER PROGRAMMES (TTOPS) - THE AT-SEA OBSERVER'S PERSPECTIVE.



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### Introduction

Monitoring of tuna transshipments (offloads) both at-sea and in port has become an important management, control and surveillance (MCS) tool for global tuna fisheries. Industry operates on a global scale, with vessels crossing multiple Regional Fisheries Management Organization (RFMO) / Regional Observer Programme (ROP) areas on a trip. Tuna and related pelagic species are also highly migratory. Management has been slow to harmonize and coordinate in order to manage these important global fisheries. Tuna Transshipment Observer Programme (TTOP) implementation among all of the tuna RFMOs remains inconsistent and disjointed.

In this talk we share perspectives from several TTOP observers in regards to practices that negatively impact the management of tuna and related species as well as discuss observer workforce limitations, frustrations, and professionalism variations with regard to TTOP ROPs; and, offer solutions from a sea-level perspective.

### Methods

Information and opinions were gathered using a web-based questionnaire targeting tuna transshipment observers which allowed anonymous responses. There were several background questions pertaining to the respondents (e.g., active observer; former observer or other; gender; primary and secondary observer programme; payment source;

hiring eligibility and training length). There were 23 statements which asked for respondents to rank from 1-5 (1 = “Strongly Agree” to 5 = “Strongly Disagree”) for their primary programme. Finally, there were eight essay response options for suggestions and comments. Because the panel presentation time allotment was limited, we focused our presentation to the 7<sup>th</sup> IFOMC on the questions that had the most comments and suggestions.

## Results

Prior to the conference, there were 11 respondents. The questionnaire remained live until May 25, 2013 (more than 2 months) for a total of 14 respondents; of these, 11 were active observers. IATTC was the primary TTOP (n=9) but all RFMOs were represented. Respondents noted that observer payment in most programmes was via a third party entity except in the Western and Central Pacific Fisheries Commission (WCPFC) where salaries were paid by the respective governments, although some travel expenses were covered directly by the carrier vessel operators (companies). There was little consistency in responses among and within programmes regarding hiring criteria and training length. This could be due to the quick changes these programmes have gone through as they developed. Therefore, depending on when the responders were hired, the responses could vary within a programme.

The overall average rank for the questions was 2.4 indicating that most of the respondents were generally in agreement. However, there were a few statements where the average dipped into the ‘disagree’ range of the rank (Table 1).

Disharmonies in the following practices negatively impact the effectiveness of management to “establish comprehensive systems... for monitoring and control of transshipments on the high seas”<sup>1</sup>:

- **Observer Professionalism:** Eligibility (including applicable experience such as observing on longline vessels), training that tests competency to perform the job, and enforceable code of conduct standards;
- **Observer and Programme Support:** One respondent suggested that the RFMOs develop an accreditation of RFMO training programme and resources (e.g. safety priority, manuals and frozen fish identification); issuance of safety and technical gear; logistical and financial means to support “qualified” observers and guard from conflicts of interest. Several respondents from the IATTC noted that their WCPFC counterparts were deployed for long periods of time (e.g. 8-10 months) while all the other RFMOs attempt to limit deployments to 90 or 120 days. Acknowledging the logistical difficulty that these global programs face, trip limits were recommended but there is some uncertainty regarding what a reasonable (or realistic) limit should be. The majority of respondents indicated that safe and clean drinking water should be a requirement for all carrier vessels;
- **“Observed” Detail:** Respondents noted that protocols for determining and designating (in the data) information collected **independently** by an observer versus information retrieved from third-party sources (e.g. vessel logbooks, fishing vessel reports, programme resources) is variable among the programmes making comparison of data from these programs a challenge. How are observer “interruptions” and “breaks” documented during transshipment activities? How are transshipment activities categorized or divided, based on: product origin, product destination, weather, etc.? Are scales made available to observers? How are observers interacting with fishing vessels (do they board fishing vessels)? How are tally-count precision and species identification accuracy determined and verified?
- **Vessel Detail:** Protocols for identifying vessels and vessel interests (e.g. operator and owner, home port, company address, etc.); photo evidence (what photos are taken, how categorized and described, verified by way of vessel photo database); how this information is categorized and recorded (in declarations), and verified by observers; and, how this information is updated from observer input and shared back with observers in the field;

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<sup>1</sup> United Nations. 2004. Resolutions and Decisions adopted by the General Assembly during its fifty-ninth session. Volume I Resolutions (59/25). 14 September - 23 December 2004.

- **Logbook and Declaration Forms:** Protocols that define information (including metadata) to be reported in fishing vessel logbooks and carrier vessel logbooks and declaration forms. Over half of the respondents noted that a standardized fishing logbook would be beneficial;
- **Species and Product Type Detail and Verification:** Fishing vessel, carrier vessel, port, and observer protocols for determining species (e.g. FAO codes and common names) and species product-types and codes; conversion factors from length to weight;
- **Port (State) Reporting and Monitoring:** National ('State') protocols for port transshipments, which are dealt with out of the primary scope of the RFMOs; and, product offload destination monitoring procedures and international (RFMO) inspections options;
- **Compliance Reporting, Accounting, and Enforcement:** Collecting evidence; on-board safety reporting (including communication procedures); formal reports (including affidavits); enforcement communication and observer follow-up. Several observers noted that fishing vessel boarding/inspection should be required in all TTOPs;
- **Transshipment Procedures:** Protocols for how fish are hoisted from fishing vessel to carrier vessel (directly out of hold or placed on deck) with consideration for observer duties. Several respondents suggested a requirement for a string of fish be composed of a single species in order to improve the quality of observer data and that inline scales be required to obtain actual weights. Observer duties could also include monitoring of scale calibration. There was general support for keeping shark fins attached prior to transshipment and observer should be authorized to open the bags of product to verify contents;
- **Fishing Vessel Support Accounting:**

Tracking bait, oil delivery/disposal, crew, vessel parts, and food stuffs.

### Discussion

It was established at the 6<sup>th</sup> IFOMC, "tuna RFMOs generally have many of the same objectives and purposes" and some see this essentially as a "worldwide observer programme"<sup>2</sup> and most of the recommendations from the 2009 meeting were reiterated in respondents comments here. The multitude of authorities that manage worldwide Tuna Transshipment Observer Programmes can work at better defining standards and harmonizing with other authorities, with regards to: transshipment procedures and reporting protocols; observer and port monitor recruitment, training, duties, roles and support; observer data accountability; and, compliance reporting and enforcement. The exchange of information, staff, and observers from one RFMO to another will not only help with harmonizing protocols for TTOPs worldwide, but establish better avenues for sharing expertise and clearer paths for acknowledging "comprehensive" and "responsible" management and pitfalls.

A more detailed summary report based on this questionnaire can be downloaded at: <http://www.apo-observers.org/labor>.

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<sup>2</sup> Belay, B. and K.G. Davis (Eds.). 2010. 6th IFOMC Tuna Transshipment Observer Program (TTOP) Meetings. pp. 311-315 In: NMFS. 2010. Proceedings of the 6th International Fisheries Observer and Monitoring Conference. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-107.

**Table 1:** Questionnaire statements and average ranks (1 = “Strongly Agree” to 5 = “Strongly Disagree”).

Statement	Average Rank
1. Observer rights are respected and protected.	2.1
2. Observers are independent data collectors and are supported well to be free from conflicting financial interests.	1.8
3. Observers understand the objectives of their programme and their role(s) and duties are well defined.	1.5
4. It is clearly documented as to how observers are expected to conduct themselves professionally and observer codes of conduct are enforced.	1.7
5. Observer hiring eligibility and training requirements are adequate for preparing observers for their job.	2.0
6. Observers are supported (with trainings, field manuals and guides, issued gear, enforcement follow-up, etc.) to complete all of their duties.	1.5
7. Observers have adequate access to carrier vessel facilities and equipment needed to complete their duties and live on-board unimpeded.	2.0
8. Observers’ health and safety risks are minimized (with trainings, competency testing, issued gear, pre-sea vessel safety checks, drills, right to refuse an assignment, etc.) during all stages of their employment.	2.2
9. All observers in my Primary ROP collect and verify fishing vessel identification information by way of the same clear and consistent methods.	2.2
10. All observers in my Primary ROP collect photo evidence of fishing vessel identification markings (when alongside carrier vessels) by way of the same clear and consistent methods.	1.8
11. Fishing vessel identification materials (provided to Observers from my Primary ROP) make good use of observer information collected in the field and are regularly updated and provided to observers.	2.7
12. All observers in my Primary ROP identify and report upon fish species and product types by way of the same clear and consistent methods.	2.2
13. Fishing vessel logbooks are standardized (from one fishing vessel to another; including protocols for how fishing vessel personnel are to complete all parts) with consideration for the data needs of the observer programme.	3.4
14. ROP Transshipment Declaration Forms are standardized (from one carrier vessel to another; including protocols for how carrier vessel personnel are to complete all parts) with consideration for the data needs of the observer programme.	2.2
15. Observer data contributes to the mission of preventing, deterring, and eliminating illegal unreported and unregulated (IUU) fishing and allows for rapid response to IUU fishing.	1.8
16. Observer compliance reporting is supported by enforcement follow-up.	2.7
17. Through post-deployment data editing/debriefing observer data is determined to be of high quality.	1.8
18. Port transshipment activities (outside ROP authority; under port state authority) do not jeopardize the mission of preventing, deterring, and eliminating IUU fishing.	3.3
19. Observer data from my Primary ROP is comparable with observer data from other TTOP ROPs in order to contribute towards the global mission of preventing, deterring, and eliminating IUU fishing.	2.5
20. To the best of my knowledge, my Primary ROP promotes industry (monitored entity) knowledge and understanding of the need for and their cooperative participation in accommodating observers.	2.2
21. To the best of my knowledge, observers in other ROPs are held to the same hiring eligibility requirements and code of conduct standards as are observers in my Primary ROP.	3.6
22. To the best of my knowledge, observers in other ROPs are held to the same training and data accountability (data editing/debriefing) standards as are observers in my Primary ROP.	3.8
23. To the best of my knowledge, all of the five TTOP ROPs work well together to cooperate in addressing (especially with regards to facilitating observer programmes) the global mission of preventing, deterring, and eliminating IUU fishing.	3.7

## OBSERVERS WITHOUT BORDERS, THE CROSS-ENDORSEMENT OF TUNA PURSE SEINE OBSERVERS IN THE PACIFIC OCEAN



Altamirano, E

Inter-American Tropical Tuna Commission.

In 2011, the two Tuna Regional Fisheries Management Organizations (Tuna RFMOs) in the Pacific Ocean signed a memorandum of cooperation for the cross-endorsement of approved observers when observing on the high seas of the convention areas of both organizations. Currently, tuna purse seine vessels of carrying capacity greater than 362 t (large purse seiners), operating east and west of the Pacific Ocean, are required to have an observer in all their fishing trips. A small number of these vessels are registered in both oceans and, occasionally, fish on both areas during the same trip having to carry two observers that record data and report on compliance issues for both organizations. Since 2002, the Inter-American Tropical Tuna Commission (IATTC) has tried to deal with this situation as a small number of large purse seiners that normally operate in the Western and Central Pacific Ocean (WCPO), and are also participants in the Eastern Pacific Ocean (EPO) fishery, the area under the management of the IATTC. These vessels have observers that are deployed by regional observer programs under the authority of the Western and Central Pacific Fisheries Commission (WCPFC). During meetings in 2002 and 2005, the IATTC and the regional organization that provide observers for this vessels, the Forum Fisheries Agency, discussed the differences and similitudes of the details of data collected by both organizations. Except for the format, it was identified that the data are very comparable and that the only main differences were related to one mode of fishing that is common in the EPO, but not in the WCPO, fishing on tuna schools associated with dolphin herds. Data on these activities must be reported to the IATTC to review compliance with its resolutions and to the parallel program managed by the IATTC staff in the EPO; the Agreement for the International Dolphin Conservation Program. During March 2012, the IATTC staff participated in a technical workgroup organized to harmonize the data collection from all these observer programs, held in Sukarrieta, Spain. The meeting was sponsored by the International Seafood Sustainability Foundation and it is part of the strategies outlined by the joint meeting of the Tuna RFMOs' called the Kobe Process, which seeks to improve coordination across the whole range of RFMO activities, including scientific research, tracking of products, monitoring and surveillance, and the impact of by-catches. This presentation highlights the most important aspects of the data harmonization needed to produce consistent databases that could help the researchers in different regions do joint or comparative studies, and at the same time to facilitate the monitoring and enforcement of their regulations. These efforts should be extended to other fisheries because they allow the sharing of databases and experiences that are the most efficient and cost-effective way to improve data quality in all of them.



## SESSION 10

### How can Fishery Monitoring programs support an Ecosystem Based approach to Fisheries Management?

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Internationally fisheries management organizations have been directed to move towards Ecosystem Based Fisheries Management (EBFM). In its basic form EBFM includes accounting for all sources of mortality imposed on a species (catch accounting), impacts from fisheries on all species (bycatch), ecosystem components and habitats (benthic impacts) and demonstrating adherence to the precautionary approach. More broadly EBFM may include monitoring of mean trophic level, species diversity, species distributions and size spectra in impacted ecosystems.

## Panelists

### A CASE STUDY: DOES THE IMPLEMENTATION OF THE NORTHWEST FISHERIES SCIENCE CENTER OBSERVER PROGRAM SUPPORT AN ECOSYSTEM-BASED APPROACH TO FISHERIES MANAGEMENT?



Perry, A.

Pacific States Marine Fisheries Commission, West Coast  
Groundfish Observer Program.

#### Introduction

When utilizing an ecosystem-based approach to management (EBM) in fisheries, it is important to analyze the benefits versus the costs of traditional single-species management (SSM) approaches. In the SSM and EBM schemes, each species' biomass estimate is used to determine what the allowable biological catch (ABC), also referred to in the US as the Annual Catch Limit (ACL) for the year should be to maintain optimum yield (OY). There are shortcomings to managing using either approach. Incomplete data sets make for imperfect biomass estimates. Since sufficient data do not exist for certain individual species, the problems of insufficient data to support EBM models are multiplied. There are and will always be data limitations in modeling/estimating species biomass (it is not possible to know exactly how much of any species of fish are in the sea), and it therefore extrapolates that these issues will be compounded by taking a multi-species or ecosystem-based approach to management. A limitation that exists solely for SSM is its inherent over-simplicity; it fails to account for interspecific interactions and interdependencies. Similarly, EBM uses the best available data to determine the health of stocks, but recognizes this interrelatedness between species and attempts to make adaptive management decisions based on the health of multi-species complexes and food webs in an ecosystem, as well as the overall health of the ecosystem itself.

In a report issued to the US Congress by the Ecosystem Principles Advisory Panel of the National Marine Fisheries Service, it was recommended that fishery management plans use an ecosystem-based management approach to marine stocks.<sup>1</sup> This report proclaimed that managing single species or creating management plans that focus on just

<sup>1</sup> NATIONAL MARINE FISHERIES SERVICE. 1999. Ecosystem-Based Fisheries Management. *A Report to Congress by the Ecosystem Principles Advisory Panel*, NMFS, Department of Commerce.

one species at a time is not an effective long-term strategy. According to a study by Worm et al., a diverse ecosystem demonstrates more robustness to adverse impacts<sup>2</sup>. The study used a meta-analytical synthesis of numerous data sources for examining varying levels of marine biodiversity on primary and secondary productivity and ecosystem stability. The authors define ecosystem stability as the ability (of an ecosystem) to withstand/recover from recurring disturbances. The authors found that increased biodiversity increased an ecosystem's ability to resist/recover from such perturbations. The authors claim that the data support increased diversity throughout the food chain; as variety of diet increased, so too productivity and hence overall diversity improved. This interrelatedness and interdependence of species in diverse ecosystems points to the benefits, or I assert the necessity, of ecosystem-based adaptive management techniques.

The Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), and the Magnuson-Stevens Fishery Conservation and Management Act (MSA) all contain protections for habitat and ecosystem health analysis and monitoring recommendations<sup>3</sup>. The MMPA established a need to protect significant geographic areas, relating the health of the species to the health and stability of the marine ecosystem. The MSA establishes the need to define, designate, protect and restore Essential Fish Habitat (EFH). The ESA establishes critical habitat as geographic areas containing physical and biological features essential to conservation of species. Despite differing definitions, all of these Acts by Congress recognize that management of species is inextricably related to the ecosystem and marine environment.

### Methods

The method in this case is the actual enactment of the Individual Fishing Quota (IFQ) system by the Pacific Fisheries Management Council (PFMC) via Amendments 20 and 21 to the Groundfish Fishery Management Plan (FMP), and the implementation of the FMP by the Northwest Fisheries Science Center Observer Program (NWFSCOP). Under the IFQ management scheme, an individual is given "ownership" of a share (or percentage) of the Annual Catch Limit set each year for each species. Here on the west coast of the United States, the new IFQ program comprises 62 species demarcated by IFQs. While these quotas are individually allocated on a per-species basis, this is an ambitious example of EBM because multi-species management of this many IFQ species had not been previously attempted, and it is recognized that complex ecosystems require species-complex based fishery management plans.

There are a growing number of definitions for what comprises Ecosystem-Based (Fishery) Management. I will present some components for this analysis that seem to be universal to the myriad definitions. Unifying components of EBFM: it: 1) accounts for ecological processes (e.g., interspecific interactions, natural mortality, trophic dynamics, energy/biomass transfer); 2) considers external influences (physical, chemical, climatological, and oceanographic processes, etc.); 3) includes a socioeconomic dynamic that recognizes human interactions, pressures, influence, and place within the ecosystem; 4) adheres to Precautionary Principle; 5) accounts for fishery catch and bycatch (fishing mortality); and (6) uses adaptive management techniques. I will discuss how the FMP embodies principles outlined by EBFM, and then demonstrate how the NWFSCOP uses observer resources to support EBFM principles.

### Discussion

The main challenges associated with EBM strategies lie in the need to collect the best data from as many sources as possible. When dealing with complex ecosystem dynamics and food webs this is a daunting task, and complete understanding is an unrealistic goal due to too many variables. However, under the FMP, observer coverage went from roughly 25% of the trawl fishery to 100% observer coverage. Although this still does not give stock assessors a perfect picture of what is in the ocean, it gets much closer to the goal of estimating fishing mortality. It also gives the fishers 100% accountability for their catch. If an individual's quota for ANY species is exceeded, the fisher must end fishing for all of their quota, or trade, purchase or lease quota to cover the deficit.

The FMP allows fishers to make use of differing targeting strategies to harvest their quotas. Between trips, a vessel may switch gear types (gear switching within trips is currently being examined as well). This has several

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<sup>2</sup> Worm et al. 2006. Impacts of biodiversity loss on ocean ecosystem services. *Science*: 314, 787-790.

<sup>3</sup> Baur, D.C., Eichenberg, T., and Sutton, M. 2008. *Ocean and Coastal Law and Policy*. American Bar Association, Chicago.

mutually beneficial outcomes. The first allows fishers to target specific species or species groups for which they have quota, such as sablefish, with longline or with pot gear (or other gear). In doing so, theoretically many detrimental impacts to the benthos by trawling are mitigated. The condition of the fish, and therefore their marketability, are also significantly improved, allowing fishers to reap much higher ex-vessel prices for their fish.

Another factor driven by the IFQ FMP implementation has been on the markets. By giving fishers, and plant owners, shares of the ACLs, some of the responsibility to manage the fish can be given to the quota owners. On the west coast of the United States, this has resulted in the industry being able to induce the plants to maintain markets for all catch. A secondary effect of this has been greatly decreased discards. Under the old west coast trawl management scheme, quotas were managed by landings rather than by catch. If a vessel exceeded their quota, they could continue to catch more fish and simply discard them. If a fish is extracted under the new scheme, it goes against the owner's quota for that species, regardless of whether it is retained or discarded. With industry pressure on the plants to sell all IFQ species catch, discard rates have declined dramatically compared to the former model.

How does the NWFSCOP inform EBFM? 100% observer coverage and shoreside monitoring attempts to account for all fishing mortality, both for IFQ species and for bycatch. Using observer data and other data sources, stock assessors set ACLs that adapt to year-to-year biomass changes. By collecting sex, age, and length data, stock health and stock-complex information are supported. Other forms of observer data collection that inform ecological dynamics of EBFM models are biospecimen DNA tissue samples from ESA-listed species: salmonids, green sturgeon, eulachon smelt, and eulachon stomachs. By collecting coral DNA specimens, fishing-gear-benthos interactions are shown. Observers collect marine mammal and seabird interaction and take data as well. Observers collect data on all discard—including many invertebrates—that are not managed under the FMP. However, these data can be accessed in future to examine in greater depth the effects of fishing interactions and overall ecosystem health.

Despite the difficulties associated with collecting these data and generating ecosystem models, internationally there is a trend to adopt EBM models as fishery management plans. Regional fishery management organizations (RFMOs) are established in varying geographic locations to establish local FMPs, and there are increasing examples of EBM based FMPs. Schiffman, 2007, points to the Commission on the Conservation of Antarctic Marine Living Resources as being exemplary in establishing an EBM-based approach<sup>4</sup>. Sanchirico et al., 2008, propose a solution to the problem of analyzing trade-offs in harvesting multiple interacting species. The authors use economic portfolio theory as a guideline for defining a metric for assessing these tradeoffs and defining risk preferences for managers<sup>5</sup>. EBM requires the gathering of far more data based on complex interactions and species integration for policy-making decisions, and this coordination presents the greatest challenge to ecosystem-based management schemes in the future.

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<sup>4</sup> Schiffman, H.S. 2007. Moving from single-species management to ecosystem management in Regional Fisheries Management Organizations. 13 *ILSA J Int'l & Comp L* 387.

<sup>5</sup> Sanchirico et al. 2008. An empirical approach to ecosystem-based fishery management. *Ecological Economics* 64: 586-596.

## THE ROLE OF SCIENTIFIC OBSERVER DATA IN UNDERPINNING ECOSYSTEM BASED FISHERIES MANAGEMENT IN CCAMLR



Eric Appleyard

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The CCAMLR convention area is large, covering approximately 11% of the world's ocean, and is remotely located in the southern ocean. It is due to its size and remoteness that conducting independent scientific research surveys are expensive and therefore increasingly scarce. However scientific observers working in CCAMLR fisheries provide an essential source of data for managers and scientists. CCAMLR's objective is to conserve marine living resources, where conservation also includes the rational use of the resource such as fishing. The conservation principles of the Convention embody an "ecosystem" and "precautionary" approach to living resource conservation. The implementation of EBFM requires data on the effects of fishing on target, dependent and related species. Dependent species are those species that feed on the target species or are impacted by the removal of the target species from the food web. Related species are typically those that are impacted directly by the action of fishing e.g. through by-catch or incidental mortality. While the monitoring of dependent species is often fishery independent, the impacts of fishing on target and related species is often best collected during fishing. For a particular fishery the impacts on target and related species will depend on a range of factors and in CCAMLR fisheries observers record information on the gear configuration (including measures to reduce incidental mortality of seabirds and marine mammals), fishing operations, catch composition, biological data on target species including tag/recapture data and data on non-target catches including fish, seabirds, marine mammals and of vulnerable marine ecosystems (VME) indicator taxa.

CCAMLR implements EBFM in all Antarctic krill and finfish fisheries. As an integral part of this, CCAMLR scientific fisheries observers' record information and data on a broad range of taxa from sponges to sperm whales with clear priorities set by CCAMLR. For example, in the 1990's, observers played a significant role in the development of implementable and effective measures to eliminate seabird by-catch. More recently, observer priorities have focused on the sea floor with the requirement to provide data on fishing interactions with VME taxa. Data collected by scientific observers provides both a means to study the impact of fisheries and is a source of fundamental information to better understand the dynamics of the Antarctic ecosystem.

## AZORES FISHERIES OBSERVER PROGRAM: GATHERING DATA FOR ECOSYSTEM BASED MANAGEMENT



Machete, M., Morato, T., Pham, C., Afonso, P. S. Santos, R.

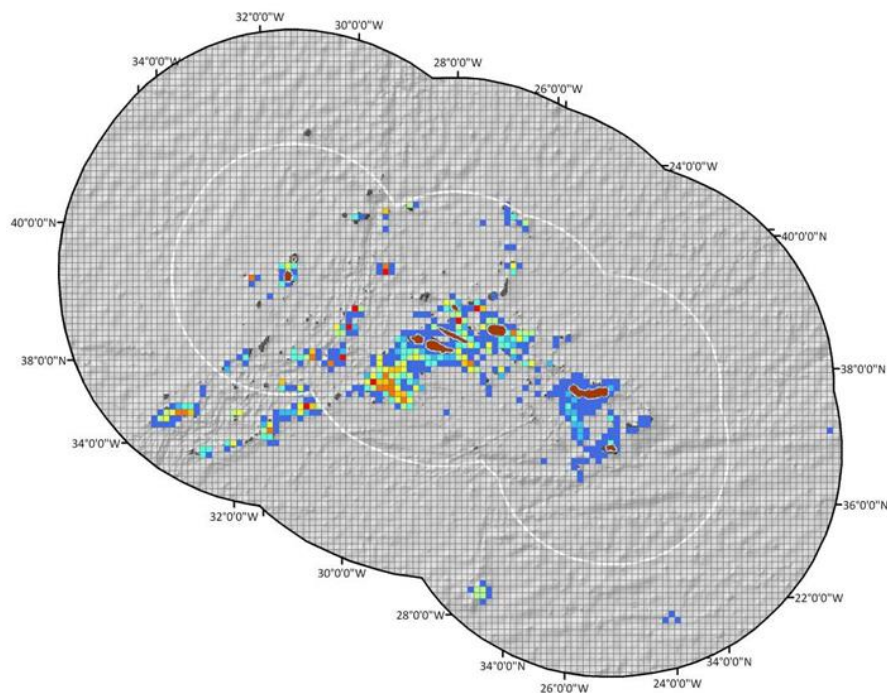
Institute of Marine Research – Center of IMAR of the University of the Azores, Portugal.

### **Azores Fisheries Observer Program (POPA)**

The Azores archipelago (NE Atlantic) is composed of 9 islands and has a maritime territory of nearly 1 million km<sup>2</sup>. Local regulations (MPAs, closed areas, minimum sizes) have been implemented since the 80's and management practices were adopted in order to achieve fisheries and environmental sustainability. However, more information is needed to understand the full array of interactions between fishing activity and the surrounding ecosystem. The Azores fisheries Observer Program (POPA) was created in 1998 to assure the Dolphin Safe certification to the pole-and-line tuna fishery in the Azores. Additionally, it has contributed significantly in gathering information that can be used for implementing ecosystem based management in the Archipelago. With the canning industry boat owners association and Earth Island Institute NGO as partners, POPA

is supported by the regional administration and managed by the Institute of Marine Research (IMAR) at the University of the Azores. POPA observers have covered more than 20,000 tuna fishing events and have collected data on experimental fisheries (e.g. black scabbard fishery), have collected information about fishing operation, catches, bycatch, discards and species associations. In recent years, POPA expanded its coverage to trap fishing, handline, bottom and pelagic longline. Two recent examples were developed within the scope of 2 EC/FP7 projects: CORALFISH (<http://www.eu-fp7-coralfish.net/>) and MADE (<http://www.made-project.eu/>). Here, we give an overview of the recent developments of the program with highlights on the main scientific results.

Observer data was used to validate Vessel Monitoring System (VMS) data analyses; Morato et al. (unpublished data) developed a reliable and repeatable method for analyzing pelagic and bottom longline VMS data by validating the outputs of the models with POPA/CoralFish/Made observer data. A total of 144 fishing sets deployed in 2008 and 2010 by two Portuguese boats were available for comparing with the VMS data. Vessels states and rules were defined and models were validated using a quasi-Bayesian approach. Those results were used to produce fishing effort maps (Figure 1) and estimate catches for the last sixty years. Overall, the methodology could identify about 80% of the real fishing pings with less than 10% of false positives.



**Figure 1.** Fishing effort map for bottom longline vessels. Colour scale goes from very low (dark blue) to very high (red).

Observer data to quantify discards and unreported catch in pelagic and bottom fisheries

Total fisheries official statistics include nominal catches, failing to incorporate what has been truly extracted from the marine environment. Pham et al. (2013)<sup>1</sup> estimated Illegal, Unreported and Unregulated (IUU) catch in the Azores and provide an improved compilation of official catches from 1950 to 2010. In this study<sup>1</sup> used multiple outputs from different observer program to reconstruct the total removals from the Azores. They concluded that the total reconstructed removals summed approximately 0.9 million tons (for the period 1950-2010), 14% more than reported in official statistics. The low level of unreported catches compared to other location might reflect the small-scale type of the fisheries, geographic isolation of the islands, and the small size of its community, coupled with an embedded conscience for the need of conserving marine resources.

<sup>1</sup> Pham, C., A. Canha, H. Diogo, J.G. Pereira, R. Prieto, T. Morato (2013) Total marine fisheries catch for the Azores (1950-2010). ICES Journal of Marine Science 70(3): 564-577. <http://dx.doi.org/10.1093/icesjms/fst024>

***Observer data to promote technical mitigation measure to reduce bycatch of sharks and undersized fish in the pelagic longline***

Discards and juvenile bycatch is a major issue in the pelagic longline fishery. Afonso et al. (unpublished data) used the observer program to monitor the catch composition and discards in the pelagic longline gear and evaluated the juvenile catches in 3 commercial vessels around the Azores and mainland Portugal between 2008 and 2010 under the scope of FP7/MADE project. In a total, 163 pelagic longlining fishing sets were monitored. Afonso et al. (unpublished data) found that juveniles of both swordfish (*Xiphias gladius*) and blue shark (*Prionace glauca*) composed more than 50% of the total catch. They also found 85% of immature blue shark in total catches. Observers on-board pelagic fishing vessels also monitored 42 longline sets with hook timers and temperature depth recorders. In this study they tested different gear configurations and deployment hours to evaluate technical measures to reduce bycatch of undersized fish. The authors concluded that monofilament leaders (rather than wire leaders) produced larger catches of swordfish and lower catches of blue shark and that fishing sets during the day should be avoided to reduce blue shark by-catch. However they found no effective measures yet to reduce juvenile by-catch.

***Observer data to quantify live bait fish used in the pole and line tuna fishing***

The pole-and-line tuna fishery is the most important fishery in the Azores in terms of catch and has been recognized since 2001 as sustainable and environmental friendly by the Friend of the Sea NGO. However, this fishery depends on bait fish whose captures are not officially declared but are being recorded by POPA observers. Pham et al.<sup>1</sup> analyzed more than 3000 bait fish operations between 1998 and 2010. Due to the seasonality in tuna and bait species, they have analyzed the bait catch independently for each tuna species. After all assumptions were met, regression analysis between each tuna species and bait fish catches was computed. The resulting equations were used to calculate bait fish catches according to the amount of tuna caught for a particular year. Pham et al.<sup>1</sup> extrapolated bait fish amounts to the all tuna fleet and estimate the bait fish catch for the last 60 years. In order to catch the reported 350,000 tonnes of tunas over the period 1950-2010, the amount of bait fish required was estimated to be 16,800 tonnes, i.e. about 5% of total tuna landings. Azorean tuna fishery requires an average of 280 tons of bait fish per year and has a tuna: baitfish ratio of 21:1, which is similar to ratios reported for other pole-and-line fishing operations<sup>2</sup>.

***Observer data to elucidate the impact of bottom longline on cold water corals (CWC)***

Bottom long line and hand line fishing are also important components of Azores fisheries. The impact of those gears in bottom communities specifically in deep water corals (DWC) has being recently highlighted as an important conservation issue that is being evaluated under the FP7 CoralFish project. Morato et al. (unpublished data) analyzed DWC bycatch data from 380 longline sets and 550 handline operations monitored by POPA/CoralFish observers in 2010 and 2011. The analysis of the data collected revealed that 51.7% of the longline sets had CWC bycatch. On the other hand, only 3% of the handline sets had bycatch. Overall, 43 different CWC taxa (including sponges) were registered in the bycatch of bottom longlines. They used GAMs to predict CPUE (N° of DWC/1000 hooks) and concluded that there is no significant bycatch of DWC in hand-line fishing. For bottom long line they estimated a bycatch of 0.3 DWC/1000 hooks which is 300 to 1000 times less than a single bottom trawl, in other areas of the Atlantic.

**Conclusions**

The observer program has been crucial in gathering essential information regarding fishing effort distribution, catch composition, fish stock distribution and composition, coral aggregations distribution, and the impact of fisheries on vulnerable marine ecosystems. This program has been extremely important due to the great amount of different data collected *in situ*, but this is only a first comprehensive glimpse into these extremely complex and variable ecosystems, and a continuation of the program would allow amplifying, refining and adding solidity to the obtained results. In order to accomplish an effective management strategy of natural marine resources in the Azores, it is essential to provide an ecosystem based analysis of human impacts in marine ecosystems. Those impacts are measured and recorded by POPA fisheries observers providing essential information to integrate into a single framework that can lead to a better understanding of the physical, ecological, fisheries, economical, and social attributes of the region. With this knowledge, harmful trends could be mitigated and reversed whilst ensuring economic benefits of sustainable fisheries in the future.

<sup>2</sup> Gillett, R., 2011. Replacing purse seining with pole-and-line fishing in the central and western Pacific: Some aspects of the baitfish requirements. *Marine Policy* 35(2): 148-154.

## IMPORTANCE OF THE POPULATION, ENVIRONMENTAL AND FISHING EFFORT VARIABILITY IN THE APPLICATION OF THE MSC-CSIRO PSA ON AN INDUSTRIAL FISHERY LIKE THE ARGENTINEAN HOKI FISHERY



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<sup>3</sup> Food and Agriculture Organization, Argentina.

<sup>4</sup> Instituto Nacional de Investigación y Desarrollo Pesquero, Argentina

### Introduction

The Productivity Susceptibility Analysis (PSA) developed by the Australian Commonwealth Scientific and Research Organization (CSIRO) was originally thought to be applied on small scale and artisanal fisheries. The current Marine Stewardship Council (MSC) methodology accepts its application to all fisheries seeking certification to the MSC standard. This risk methodology is not only useful to estimate risks of fishery impact on certain species and to detect weaknesses of the fishery, but occasionally may represent a key instrument in fishery certification decisions. The PSA consists on assessing key attributes related to the species physiology as well as the fishery-species interactions to obtain an overall risk result. Amongst these attributes, the availability depends on the overlap between fishing activity and species occurrence while the vertical overlap reflects the probability of interaction between fishing gear and the species considered. Usually, a deeper analysis of these attributes is possible on industrial fisheries because of the available richer information in comparison to artisanal ones. PSA can be applied when fisheries information is incomplete or to contrast with other available results. In this work we applied PSA on target and retained species to the Argentinean hoki (*Macruronus magellanicus*) fishery, one of the most economically significant to the country and which was certified to the MSC Standard, using a particular formula to calculate the availability overlap.

### Methods

We developed and applied a set of formulas for the availability attribute considering the species occurrence and the fishing effort variability across geographic coordinates<sup>1</sup>. The formulas are as follows:

$$AOI = \frac{EOA}{SEOA}$$

$$EOA = \iint_{\text{whole stock distribution}} P(\text{Lat}, \text{Long}) \cdot f(\text{Lat}, \text{Long}) \cdot Y(\text{Lat}, \text{Long}) \cdot d\text{Lat} \cdot d\text{Long}$$

$$SEOA = \iint_{\text{whole stock distribution}} P(\text{Lat}, \text{Long}) \cdot Y(\text{Lat}, \text{Long}) \cdot d\text{Lat} \cdot d\text{Long}$$

Where: **AOI** is the Availability Overlap Index; **EOA** is the Effective Overlap Area; **SEOA** is the Species Effective Occurrence Area; **Lat** is latitude and **Long** is longitude; **P(Lat, Long)** is the probability of occurrence of the species; **f(Lat, Long)** is the normalized fishing effort function and **Y(Lat, Long)** is the (spherical-coordinates) area projection function.

Based on the available data, a discrete version of the formulas above was applied on statistical quadrants of 1° latitude per 1° longitude, which is as follows:

$$\text{Availability Overlap index (AOI)} = \frac{\sum_{i=1}^n P_i f_i A_i}{\sum_{i=1}^n P_i A_i} = \sum_{i=1}^n f_i \cdot \frac{P_i A_i}{\sum_{i=1}^n P_i A_i}$$

Where: **P<sub>i</sub>** is the probability of occurrence for the species in study at statistical quadrant **i** (Aquamaps -Fishbase); **f<sub>i</sub>** is the normalized fishing effort at statistical quadrant **i** (as a the proportion between the fishing effort at statistical quadrant **i** and the maximal fishing effort amongst all statistical quadrants); **A<sub>i</sub>** is the area of the statistical quadrant **i** and **n** is the number of statistical quadrants where the species occurs for the stock under consideration.

<sup>1</sup> Morales Yokobori, M. L., Prenski, L. B., & Blanco, G. 2011. A sight on the Marine Stewardship Council semi-quantitative analysis applied to an Argentinean fishery. *Procedia Environmental Sciences*, 7:122-127.

Different year-scenarios were chosen from 1998 to 2010. Species occurrence values were taken from the Aquamaps predicting model while the fishing effort data was provided as trawling hours by the Argentinean Under-secretariat of Fisheries and Aquaculture, who gathered obligatory fishing reports delivered after each trip. Data from the Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP) Observers Program were not used because of a need of having covered all quadrants where the species occurred as well as all trips. The fishing effort was normalized dividing the trawling hours occurring within each quadrant by the maximum fishing effort occurred amongst all quadrants where the fishery operates.

## Results/Discussion

Year / Species	<i>Macruronus magellanicus</i>	<i>Genypterus blacodes</i>	<i>Merluccius hubbi</i>	<i>Sallota australis</i>	<i>Squalus acanthias</i>
1998	13.92%	11.65%	14.17%	12.27%	11.41%
2001	7.88%	5.40%	7.48%	5.94%	7.63%
2003	4.84%	2.94%	4.55%	3.45%	4.55%
2005	4.41%	2.85%	4.27%	3.26%	4.16%
2006	2.30%	1.41%	2.19%	1.70%	2.12%
2007	4.54%	2.93%	4.38%	3.56%	4.33%

**Table 1:** Availability Overlap Index (AOI) obtained on target and four retained species applied to the Argentinean hake (*Merluccius hubbsi*) fleet with hoki quota. Observations: In 1999 hake fishing closed zones are created and subsequently modified according to environmental changes in the following years while in 2006 an important recruitment reduction was observed (INIDEP). The MSC scale is 1 or low risk for AOI <10%, 2 or medium risk for 10% ≤ AOI ≤ 30% and 3 or high risk for AOI >30%.

Year	2007	2008	2009	2010	Average
Availability overlap	27%	27%	28%	27%	27,25%
MSC Availability Risk	2	2	2	2	2

**Table 2:** Availability Overlap Index (AOI) obtained on target species applied to the Argentinean hoki (*Macruronus magellanicus*) fishery. The MSC scale is 1 or low risk for AOI <10%, 2 or medium risk for 10% ≤ AOI ≤ 30% and 3 or high risk for AOI >30%.

Results obtained were consistent with opinions gathered during the Argentinean hoki MSC certification process<sup>2</sup>. This may suggest a possible contribution of PSA to predict impact of fishing on species in future scenarios. The general low Availability Overlap Index obtained for the hake fleet with hoki quota on five species (Table 1) may be explained by the fact that this fleet preferably targets hake, sometimes where hoki or the other species do not occur with considerable probability. For these reasons, we consider that the PSA applied to an industrial fishery like the Argentinean hoki one must take into account the different fishery and environmental scenarios impacting on the species and fishing effort variability across the geographical coordinates, in order to approach better management and certification decisions.

<sup>2</sup> Prenski, L. Bruno; Morales-Yokobori, Marcelo L.; Minte Vera, Carolina V.; Bridi, R. Jorge; Landa, Pedro; Di Giacomo, Edgardo; Perrier, María. 2012. Argentinean Hoki (*Macruronus magellanicus*) Bottom and Semi-pelagic trawl net Fishery. Assessment against MSC Principles and Criteria. Final Certification Report. OIA, 822 pages.



## SELECTIVE OR LESS SELECTIVE: WHAT CAN OBSERVER DATA TELL US ABOUT FISHING PRESSURES ON MARINE COMMUNITIES FROM THE SOUTHERN BAY OF BISCAY?



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### Introduction

To develop an ecosystem approach to fisheries management, indicators of the pressures of fishing on marine communities are required<sup>1 2</sup>. Onboard observer programmes were developed worldwide to answer the need to identify and quantify the whole catch and distinguish between landings and discards<sup>3 4</sup>. Data from the national onboard observer programme can thus be used to characterize the fishing pressures by providing catch composition by species and length for the whole catch<sup>5</sup>, as well as data on the fishing métiers. Improving the selectivity of fisheries is considered one of the main goals in current fisheries management to limit the impacts of fisheries. However, this concept has been recently reassessed and may not be suitable when considering fisheries impacts on the whole marine community<sup>6 7</sup>. Some scientists argue that considering an ecosystem approach of fisheries, the preferred removal of large species, often predators, and of the largest individuals could destabilize the ecosystem and trophic chain<sup>8</sup>. A balanced fishery, i.e. proportional to the relative abundance or production of each species in the community, could be more appropriate<sup>8</sup>. However, few empirical studies have been undertaken to study these questions. Before taking action and designing exploitation strategies at the community level, there is a need to provide empirical evidence for the impacts of selective versus less selective fisheries on marine communities. The objectives of this study are to: i) propose and evaluate metrics designed to inform on selectivity, ii) characterize the selective extraction of different commercial fishing gears, and iii) examine whether empirical differences in selectivity between sites harvested with different combinations of fishing gears can be detected. We define the selectivity at the community level as the extraction made by fisheries from the community. This can be understood with respect either to the length distribution, or to the species composition of the catch. We oppose a selective to a diverse catch. The case-study presented here is from the Southern Bay of Biscay where a southern site was considered "selective", because it is mainly harvested by passive fishing gears, contrary to another one further north - where harvest is dominated by trawlers. Several metrics of selectivity were calculated on onboard observer data, by gear and site, to compare the pressures exerted in both sites and highlight systematic differences.

<sup>1</sup> Jennings S., 2005. Indicators to support an ecosystem approach to fisheries. *Fish and Fisheries* 6: 212–232.

<sup>2</sup> Piet G. J., Quirijns F. J., Robinson L., Greenstreet S. P. R., 2006. Potential pressure indicators for fishing, and their data requirements. *ICES Journal of Marine Science* 64:110-121.

<sup>3</sup> Attwood C. G., Petersen S.L., Kerwath S.E., 2011. Bycatch in South Africa's inshore trawl fishery as determined from observer records. *ICES Journal of Marine Science* 68: 2163–2174.

<sup>4</sup> Alfaro-Shigueto J., Mangela J.C., Pajuelob M., Duttonc P.H., Seminoffc J.A., Godleya B.J., 2010. Where small can have a large impact: Structure and characterization of small-scale fisheries in Peru. *Fisheries Research* 106: 8–17.

<sup>5</sup> Wehrtmann I.S., Nielsen-Muñoz V., 2009. The deepwater fishery along the Pacific coast of Costa Rica, Central America. *Latin American Journal of Aquatic Research* 37: 543-554

<sup>6</sup> Zhou S., 2008. Fishery by-catch and discards: a positive perspective from ecosystem-based fishery management. *Fish and Fisheries* 9:308–315.

<sup>7</sup> Garcia S. M., Kolding J., Rice J., Rochet M.-J., Zhou S., Arimoto T., Beyer J. E., Borges L., Bundy A., Dunn D., Fulton E. A., Hall M., Heino M., Law R., Makino M., Rijnsdorp A. D., Simard F., Smith A. D. M., 2012. Reconsidering the Consequences of Selective Fisheries. *Science* 335: 145-147.

<sup>8</sup> Rochet M-J, Collie J.S., Jennings S., Hall S.J., 2011. Does selective fishing conserve community biodiversity? Predictions from a length-based multispecies model. *Canadian Journal Of Fisheries And Aquatic Sciences* 68: 469-486.

## Methods

Data from the French onboard observer programme (2003-2012) has been used to characterize the pressures exerted by fisheries by providing catch composition by species and length for the whole catch, as well as data on the fishing métiers. The richness of the catch and the Simpson's index of evenness were used to characterize species-selectivity. Length-selectivity was characterized by the mean length and the length range width of the catch (calculated as the interpercentile range 5-95% of the length structure). The number of observed fishing operations widely differed across gears and sites. Since the median number of individuals caught by the different gears were different and assumed to greatly affect selectivity metrics - especially richness - rarefaction curves were used as a way to standardize metric estimates across gears and sites to allow comparison between them. A bootstrap was run by randomly sampling fishing operations among the population of all fishing operations per gear-site. Selectivity metrics were calculated on each sample. Thousands of replicates were drawn for each sample size varying between 1 and 20 fishing operations. Convergence with increasing sample size differed between metrics of selectivity in species and length and two methods were used for their estimation. Metrics of selectivity in species, because they kept increasing (decreasing for evenness) with increasing sample size, even if they started to converge, were estimated by determining the value of asymptote and its associated standard deviation after adjustment of a Michaelis-Menten function. The metrics of selectivity in length found a nearly immediate convergence with increasing sample size were estimated by calculating the median and standard deviation on all replicates calculated on the largest sample sizes (from 12 to 20 fishing operations). Using those estimations and associated standard deviations, we randomly resampled 500 replicates in a gaussian distribution. A two-way analysis of variance (ANOVA) was undertaken on all replicates to test the effects of gear and site on each metric using a Fisher's test. The relative effects of both explanatory variables on each metric were assessed by calculating the percentage of variance they explained. A principal component analysis (PCA) was carried out to examine the relationships between metrics through the correlation circle. Groups of individuals based on their center of gravity were represented through starplots by gear and site (north versus south) and used to compare selectivity between gears and sites.

## Results/Discussion

### → Selectivity metrics

Results from the ANOVA showed that both gear and site had significant effects on selected metrics ( $p(F) < 0.05$ ), but the gear effect was more important than the site effect (>52% of variance explained by the gear, <15% by the site) for all metrics. Length metrics were more sensitive to gear than species metrics with mean length resulting the most relevant metric to detect differences in gear selectivity (92% of variance explained). Richness was the most relevant for species selectivity (69% of variance explained). Relationships between the selected metrics were consistent through the PCA. Mean length and length range width were positively correlated meaning that the larger the mean length of the catch was, the wider the length range caught was. Richness and evenness were negatively correlated meaning the richer the catch was, the more dominated it was. This study further showed that a few samples were enough to estimate length metrics, meaning a low variability in the length selection of each gear. More samples were needed for species metrics but some convergence was found with an intermediate sample size, demonstrating that species selection is an aggregative process.

### → Comparison of selectivity between gears and sites

The grouping of individuals by gear showed significant differences of selectivity between gears, mainly correlated with length metrics: bottom trawls caught the smallest individuals and narrowest range, trammel nets, pelagic trawls and gillnets caught individuals of intermediate lengths with an intermediate range and longlines caught the biggest individuals with the widest range of length. Along the metrics of species-selectivity, no significant differences were observed across gears, except between pelagic trawls and trammel nets, the latter having a richer and more dominated catch. Those results contradict the general thinking that passive gears are more selective than active gears for both length and species selectivity. The grouping of individuals by site showed small differences of selectivity between sites, mainly correlated with length selectivity. Catch in the northern site tended to be smaller and of narrower range than in the southern site. Even if sites were selected because they are ecologically very similar but differ by the way they are harvested, further research needs to be carried out to determine if those differences are due to the differences in gears deployed in the site or to the site itself.

→ **Perspectives**

Future work includes studying the impacts of the differences in selectivity enhanced by this study on marine communities. Survey data will be used for this purpose. This study emphasizes the importance of onboard observer programmes in the ecosystem approach to fisheries management. However, marine communities taken into account in the study were limited to fish and commercial invertebrates, all species for which information are collected by the French onboard observer programme. It is likely that some (if not all) gears taken into account in this study also impact non-commercial invertebrates and benthic communities. As relevant as it would be to also characterize the pressures exerted by fisheries on those species, it cannot currently be done since only one observer is on board at a time and collecting data on fish and commercial invertebrates was a compromise between workload and scientific interest. If data on more species was to be collected, more human resources should be invested.

## AN ECOSYSTEM AND RISK-BASED APPROACH FOR ASSESSING AND IDENTIFYING LEVELS OF FISHERIES MONITORING PROGRAMS ON CANADA'S PACIFIC COAST

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### **Introduction**

Faced with a myriad of ecosystem and economic challenges, including climate change, declining and more variable fish stock abundances reduced economic viability, an evolving global marketplace, and heightened competition for aquatic resources, Canada's Pacific fisheries are undergoing reform. The growing national and international concern around ecosystem impacts of fishing and consistent with Fisheries and Oceans Canada (DFO) programs on fisheries reform, a critical spotlight is on the state of fisheries monitoring programs and the need for targeted and cost effective improvements. International commitments (i.e., Food and Agriculture Organization, United Nations General Assembly, the Convention on Biological Diversity), along with the domestic Oceans Act and Species at Risk Act (SARA), compel DFO to adopt a broader ecosystem-based approach to resource management, of which catch accountability is a significant component. An ecosystem approach to fisheries management looks beyond a single species, sector or activity to examine the cumulative impacts of human actions on the ecosystem. This means managing fisheries, not just for stock productivity (an important component of ecosystems), but also for biodiversity and habitat integrity<sup>1</sup>. This global push for ecosystem management is expanding the scope and complexity of monitoring systems. Aside from basic catch and biological sampling data on the target stock, requirements now include information on releases of target and non-target fish species, seabirds, sea turtles, marine mammals, encounters with species that are not captured, and habitat impacts. Approaches to set catch monitoring standards to respond to such a diversity of information needs is required.

Accurate and precise, timely and accessible fisheries information is the foundation of basic catch monitoring standards and ecosystem-based and stakeholder-supported management. DFO Pacific Region has taken steps to move toward ecosystem-based management approaches and setting catch monitoring standards by releasing a policy document *Strategic Framework for Fishery Monitoring and Catch Reporting in the Pacific Fisheries*<sup>2</sup> (The Framework). The purpose of The Framework is to provide a common understanding and approach to establishing fisheries monitoring and catch reporting standards and to provide guidance to Resource Managers and Harvesters (Commercial, Recreational, Aboriginal Food, Social and Ceremonial (FSC)) on catch monitoring requirements and the development and application of specific standards. However, it must be recognized that not all fisheries operate on the same basis or have the same impact therefore a risk-based approach to determine fishery monitoring and catch reporting requirements has been developed.

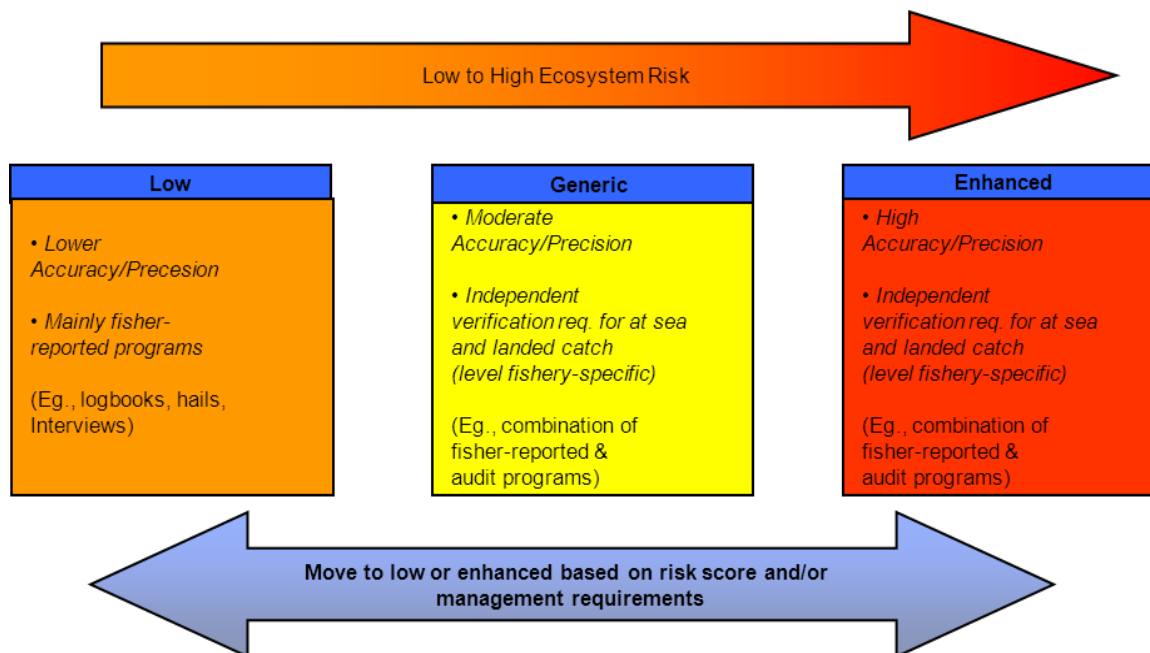
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<sup>1</sup> Fisheries and Oceans Canada. 2009. *Putting Ecosystem-based Management to Work*. Ottawa, Ontario. Available at: <http://www.dfo-mpo.gc.ca/science/Publications/article/2008/21-01-2008-eng.htm>

<sup>2</sup> Fisheries and Oceans Canada. 2012. *Strategic Framework for Fishery Monitoring and Catch Reporting in the Pacific Fisheries*. Vancouver, British Columbia Canada.

## Methods

In order to establish a common understanding of catch monitoring requirements across all fisheries and to enable consistency, three levels of monitoring have been established, Low, Generic and Enhanced, based on criteria that considers key biological and ecosystem impacts and resource management requirements (Figure 1).



**Figure 1.** Summary of catch reporting and fishery monitoring levels set based on the risk a fishery has on the ecosystem.

Monitoring requirements at each level for catch, effort and ecosystem impacts, as well as the quality of catch information and need for independent verification programs are outlined.

A risk assessment tool, to assess the level of monitoring required within a fishery is included in The Framework. The assessment is used as a decision making tool to determine the required level of monitoring and applies to all commercial, recreational and First Nation FSC fishing activities on Canada's Pacific coast and interior waters managed by DFO Pacific Region. The approach is based on similar risk analyses frameworks and approaches by DFO 2013<sup>3</sup>, Hobday *et al.*<sup>4</sup> and Holt *et al.*<sup>5</sup> and examines the risk a fishing activity presents to three categories of ecosystem component(s) (species, community and habitat impacts) and also considers the requirements of the accompanying management regime. For example, a fishery which utilizes transferable quotas and 100% catch retention would require explicit catch data and thus be assessed at the enhanced monitoring level. Given the wide application of the risk assessment across the highly variable Canadian Pacific fisheries, there was a need to adapt the methodology to keep it simple and understandable by a wide range of users (Resource Managers, Scientists, and Harvesters).

The analysis can be conducted using quantitative and/or qualitative information. For example, a number of data sources can be used including science assessments, fishery data such as catch and effort reports, local and traditional

<sup>3</sup> DFO. 2013. *Ecological Risk Analysis Framework (ERAF) for Coldwater Corals and Sponge Dominated Communities*. Available at <http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/index-eng.htm>

<sup>4</sup> Hobday, A.J., A.D.M. Smith, I.C. Stobutzki, C. Bulman, R. Daley, J.M. Dambacher, R.A. Deng, J. Dowdney, M. Fuller, D. Furlani, S.P. Griffiths, D. Johnson, R. Kenyon, I.A. Knuckey, S.D. Ling, R. Pitcher, K.J. Sainsbury, M. Sporicic, T. Smith, C. Turnbull, T.I. Walker, S.E. Wayte, H. Webb, A. Williams, B.S. Wise, S.Zhou. 2011 Ecological risk assessment for the effects of fishing. *Fisheries Research* 108:372-384.

<sup>5</sup> Holt, K.R., B. Ackerman, R. Flemming, R.E. Forrest, A.R. Kronlund, L. Lacko, N. Olsen, K. Rutherford, R.D. Stanley, N.G. Taylor, and G. Workman. 2012. Ecological risk assessment for the effects of fishing: A pilot study for British Columbia groundfish fisheries. *Can. J. Fish. Aquat. Sci.* 2990: viii + 184 p.

knowledge and information from other programs and harvesters including for example, marine mammal response networks, surveys, etc. A process for scoring the consequence and likelihood of each ecosystem component is outlined. The final score, an estimated level of ecosystem risk resulting from fishing activity, then equates to the level of monitoring required. This in turn determines the appropriate mix of fisher-dependent (e.g. logbooks) and independent (e.g. e-monitoring) monitoring tools needed (Figure 1).

### Results/Discussion

The risk assessment offers a consistent and transparent process for Resource Managers to determine appropriate monitoring levels in collaboration with harvesters. By using a consistent approach and working in collaboration with harvesters in a transparent way, DFO Pacific Region is providing a key focus to moving ahead with ecosystem based approaches to fisheries management. This approach, which takes into consideration ecosystem risk in a systematic way and recognizes the variability of information needs across the fisheries, provides transparency and rigor in the way monitoring programs are developed and implemented which has not been present in the past. It is also proving to be a key tool in fostering greater confidence amongst First Nations, commercial and recreational harvesters and Non-Government Organizations, and the general public in sector catch numbers and associated fishery management regimes.



# SESSION 11

## New and emerging observer programs

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Observer Programs have become increasingly in demand for monitoring fisheries to a finer scale due to increased fishing pressure. New and emerging programs are able to take advantage and benefit from long term, well established observer programs. The networking provided at conference such as the IFOMC fosters a “knowledge bank” that new and emerging programs can tap into as they build and develop their program. Established programs can also learn from emerging programs as innovation, new technologies, and alternative program management styles and structures are implemented. Sharing information on lessons learned and increased collaboration among the observer community contributes to refining and optimizing the work that observers programs perform world-wide

## Panelists

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### *COMPETENCIES REQUIRED BY SCIENTIFIC OBSERVERS DEPLOYED ONBOARD COMMERCIAL FISHING VESSELS IN CHILE*

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The complex state of the fisheries in Chile has led to an increased concern and a higher demand of scientific research, aimed at obtaining opportune information used by the fishing authority in the decision making process. Under this scenario, the availability of scientific research vessels is quite small, being necessary to incorporate commercial fishing vessels from the industrial and small scale fleet, to collect scientific information. In general, these commercial vessels have very constrained living and working conditions, as well as a limited infrastructure. As a result, the accommodation of extra crew or a scientific working team along with its diverse research equipment is a challenging task. These conditions establishes the need for a particular scientific observer, distinguished by having communication skills and a command of a wide range of disciplines related to fisheries research, as well as skills handling high technology equipment. Consequently, it becomes necessary to create an adequate training program in order to complement the current knowledge of scientific observers, and also to achieve better performance of more complex activities such as collection of acoustic information, bio-oceanographic sampling, meteorological data collection, navigational information, and biological sampling. Based on information gathered from scientific studies conducted onboard commercial vessels, this paper defines the competences and technical profile required by the scientific observer working on the Chilean fishing scenario.

### *OBSERVER TRAINING TO MEET CONTEMPORARY DEMANDS IN THE NORTHEAST ATLANTIC*

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In 2012, Galway-Mayo Institute of Technology (GMIT) and the Strategic Marine Alliance for Research and Training (SMART) developed and delivered a training course to equip marine industry personnel and marine science graduates with the skills necessary to collect marine biological samples and data from commercial

marine platforms. The module recognizes that all areas of marine economic development are subject to statutory data collection requirements at both national and international level. Additionally industry codes of practice necessitate the collection of data for evaluation of the sustainability of marine commercial activities on the environment, and their impacts on stakeholders. As collection of this data is increasingly contracted out to private companies and individuals the emphasis of the observer programme is to offer training in executable and marketable shipboard data collection skills. This training was delivered in the format of an accredited blended learning module composed of four days of shiptime, three days of laboratory practical's and lectures supported by online training resources. Delivery of practical skills training in applied marine sciences develops national capacity in applied marine science and marine science skills training. Our aim was to provide participants with the skills necessary to tender for data collection services to:

- National and international agencies
- Non-governmental organizations
- Small and medium enterprises and,
- Large scale marine industries (including fishing, offshore oil and gas and seabed resources, marine renewable energies, and tourism).

The skills training on the large scale marine industries module focused on data collection for fisheries, benthos, mega fauna, and biological oceanography on fishing, research and vessels of opportunity.

## THE OBSERVER PROGRAM AND ITS ROLE IN MONITORING AND CONSERVATION: A NEW TYPE OF FISHERMAN



Azocar, J.<sup>1</sup>, Lavers J.<sup>2,3</sup>, Barría P.<sup>1</sup>

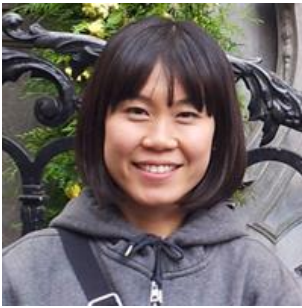
<sup>1</sup> Instituto de Fomento Pesquero, Chile.

<sup>2</sup> Institute for Marine and Antarctic Studies (IMAS), University of Tasmania, Australia.

<sup>3</sup> Australian Centre for Biodiversity, Monash University, Australia.

The Instituto de Fomento Pesquero (IFOP) has conducted monitoring of the main Chilean fisheries since the 1980s developing a national network of observers that provide information on landing ports and catch. Historically, the collection of information onboard vessels was subject to the will of the owners or fishing companies and, in some cases, access was possible only under the legal framework to develop “Fisheries Research”. In February 2006, the “Reglamento de Observadores Científicos” (ROC) was announced in Chile, which requires technicians to be present on all boats to record the tasks of industrial vessels and obtain biological information. However, in 2001, at the height of the Chilean longline fishery, intensive monitoring was voluntarily initiated on a subset of vessels using expert trained technicians to obtain biological and operational data on the target species, swordfish *Xiphias gladius*, and bycatch. These scientific observers were trained in the identification of sharks, turtles and seabirds, as well as appropriate release techniques. To assist with this process and ensure effective uptake of the observer model, identification guides, posters, manuals and promotional material were developed and supported by a program of talks, for masters and crew, to support field management. These initiatives form the basis of the first Scientific Observer program in Chile, which has substantially increased the knowledge and participation of fishers, led to improved adoption of best practices, and ensured the successful release of dozens of sea turtles and other bycatch species. In addition to obtaining reliable industrial fleet observations and biological data based on standardised protocols, these efforts provide evidence of positive uptake when information is made available to fishers, generating a change in the paradigm of the fishermen who are now committed to the conservation of endangered species. Here we review the challenges and achievements that were critical to implementing the Chilean Scientific Observer program and propose a new ecosystem approach to managing fisheries observer programs and impacts.

## NEW PHASE OF KOREAN OBSERVER PROGRAM



Lee, S.J.<sup>1</sup>, Seok Gwan Choi<sup>2</sup>, Doo Nam Kim<sup>2</sup>, Jae Bong Lee<sup>2</sup>

<sup>1</sup> Institute for International Fisheries Cooperation, South Korea.

<sup>2</sup> National Fisheries Research and Development Institute, South Korea.

Since the inception of the UN of Law of the Sea, there has been a significant improvement of fisheries resources conservation and management measures. Thus, its Member States has set forth on-board observer as obligatory requirement. With this regard, having fulfilled such international requirement, the Ministry of Maritime Affairs and Fisheries (MOMAF) has adopted and implemented a national observer program and National Fisheries Research and Development Institute (NFRDI) has operated the program since 2004. The Korean government has trained a total of 34 observers, carrying out 94 on-board activities around world oceans, including the regions of ICCAT, CCAMLR, WCPFC, SEAFO, SPRFMO, IOTC, and SIOFA.

The observer program comprises six steps: planning, recruitment, educating, on-boarding, reporting and debriefing, and submitting national reports to Regional Fisheries Management Organizations (RFMOs). NFRDI has solely operated and was responsible for the program for 10 years. In a new phase of the Korean observer program, an ambitious effort to improve our program, the Korean government launched the Institute for International Fisheries Cooperation (IFIFC) and newly employed an observer manager in August, 2012. NFRDI and IFIFC collaborate to develop the Korean observer program, that is, IFIFC is in charge of administrative work (planning, recruitment, on-boarding, reporting), and NFRDI (educating, debriefing, submitting national reports) gives scientific supports.

Furthermore, the Korean government is planning to amend the Ocean Industry Development Act, which clarifies the basis of International on-board observer program. By combining 70 domestic dockside observers in 117 fishing ports, the Korean government will run national-wide human resources database to ensure observer job stability. A more systematic and effective operating system will enable the Korean sea observer program to certify at the world-class level, reinforcing the quality of education and debriefing process.

## ALL HANDS ON DECK! IMPLEMENTING AN EMERGENCY OBSERVER PROGRAM IN RESPONSE TO THE DEEP WATER HORIZON OIL SPILL



Turk, T.

NOAA/NMFS Affiliate, USA.

The Deep Water Horizon oil spill in the Gulf of Mexico started in April 2010 and was not capped until July 2010 releasing an estimated 4.9 million barrels of crude oil into the environment. In response to the oil spill a complicated and lengthy process was undertaken to systematically document and monitor the number of sea turtles and marine mammals impacted by the spill as well as the recovery effort. The talk will discuss the challenges of working in a fast paced and ever changing response environment including: communication within the incident command system; working with BP as a partner in funding and coordinating the response effort; expediting the implementation of an observer services contract; developing observer training materials on the fly; locating trainers, equipment and housing; data and program quality control; and the logistics of placing observers on non-fishing and small fishing vessel platforms.



# 7<sup>th</sup> International Fisheries Observer & Monitoring Conference Workshops

## Data Quality Workshop (DQW)

Session lead: Oscar Guzman | IFOP, Chile.

E-mail: Oscar.guzman@ifop.cl

### **Introduction:**

Trust in data quality, information and knowledge, produced by Fisheries Research Organizations, is a matter of survival. If those products become suspicious, the organization's credibility is called into question and its reputation, as an independent source of reliable and credible knowledge, is undermined. Therefore attention to data quality management must be a matter of major concern. The knowledge required by public institutions for decision-making, leading to the sustainability or recovery of fisheries, is implicit in fisheries stakeholders, particularly fishermen. To capture this implicit knowledge and make it explicit and recorded in standard forms and high quality, Fisheries Observers (FO) are essential. All involved stakeholders in fisheries governance, must be part of a quality culture based on respect, truth and mutual reliance. If those prerequisite are not met, all attempts of fishery regulations will fail to succeed.

### **Objectives:**

Review the key aspects of scientific data collection and statistical quality, reliable basis for policy development and decision making for sustainable management of fisheries.

## DQW Presenters

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### *INTERNATIONAL PRINCIPLES AND QUALITY INDICATORS FOR FISHERIES DEPENDENT DATA*



Guzmán, O.

Instituto de Fomento Pesquero, Chile.

Trust in the quality of data, information and knowledge produced by fisheries research organizations, to achieve sustainable fishing under ecosystem approach, is a matter of survival for fisheries research organizations. Whether these products become suspicious, the institution's credibility is called into question and his reputation as independent and objective source of reliable knowledge is undermined. Therefore due attention to the management of data quality, should be a matter of major concern and priority, for all those parties involved in the institutional management. During this session we will review concepts like knowledge, quality principles and indicators applicable to fisheries dependent data and statistics, according recommendations of international organizations such as FAO, ICES, OECD and UN. We will make a quick reminder of concepts such as knowledge management, intellectual capital and data quality management, and livelihoods to achieve efficient Fisheries Observers Programs.

## IMPACT OF REAL-TIME COMPUTER ASSISTED LOGBOOK ON ANCHOVY FISHERIES DATA MANAGEMENT

Limache, J., Bouchon, M., Jordán, J., Ore, J., Callirgos, A., Huapaya, M., Vera, S.  
 Instituto del Mar del Perú, Perú.

### Introduction

The pelagic resources in the Peruvian sea show a high variability in different temporal scales, associated to the great coastal upwelling and events like El Niño<sup>1 2 3</sup>. Among these resources, the anchovy (*Engraulis ringens*) has a great importance due to the fact that it supports the most monospecific greater fishery of the world<sup>4 5</sup>



The main problem in the administration of fisheries is referred to the adoption of adequate measures of management that may allow the sustainability of the resource. In the case of the Peruvian fishery, this problem is more complicated, taking into consideration that the Peruvian sea presents a great environmental variability (events El Niño/La Niña) that incorporates more uncertainty to the diagnosis and recommendations issued. In this sense, the Instituto del Mar del Perú (IMARPE) has the mission of assessing the government in the management of fisheries resources. As part of this purpose, since 1996 IMARPE has, in a continuous form, 25 scientific observers on board of the purse-seiners fleet known as Fisheries Logbook Program, distributed in the main ports along the Peruvian littoral.

**Figure 1.** Distribution of Onboard Logbook Fisheries Observer Program in the Peruvian Coast

<sup>1</sup> Brink KH, Halpern D, Huyer A, Smith RL. 1983. The physical environment of the Peruvian Upwelling System. Progress in Oceanography 12: 285 – 305.

<sup>2</sup> Huyer A, Knoll M, Pauszkiewicz T, Smith RL. 1991. The Peru Undercurrent: a study in variability. Deep Sea Research 38: S247 – S271.

<sup>3</sup> Chavez F, Bertrand A, Guevara-Carrasco R, Soler P, Csirke J. 2008. The Northern Humboldt Current System: Brief history, present status and a view towards the future. Progress in Oceanography 79: 95-105.

<sup>4</sup> Pauly D, Tsukayama, I. 1987. On the implementation of management-oriented fishery research: The case of the Peruvian anchoveta. In: D. Pauly and I. Tsukayama (eds.) The Peruvian anchoveta and its upwelling ecosystem: Three decades of change. ICLARM Studies and Reviews 15, 351 p. Instituto del Mar del Peru (IMARPE), Callao, Peru; Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), GmbH, Eschborn, Federal Republic of Germany; and International Center of Living Aquatic Resources Management (ICLARM), Manila, Philippines, p1-13.

<sup>5</sup> Niquen M, Bouchon M, Cahuín S, Díaz E. 2000. Pesquería de anchoveta en el mar peruano. 1950 – 1999. Bol. Inst. Mar Perú 19 (1 y 2): 117-123.

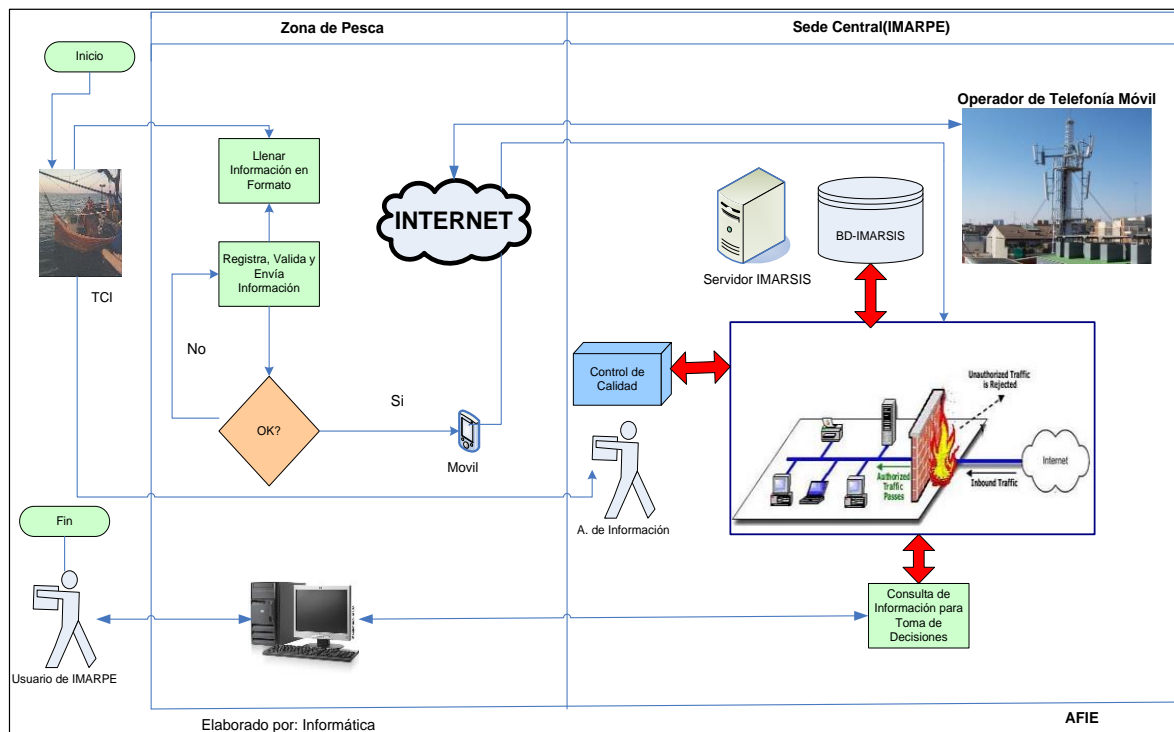
Due to the technological development happened in the last years, the sampling system in Peru evolved from the traditional one realized in the landing ports to observations in the same fishing areas, to improve the time of the analysis of the information, same that was optimized with the use of a WAP Application (mobile telephone) on real time and with the follow up of satellite data.

**Methodology**

IMARPE since 1996 is recollecting information in the Peruvian sea through the Observers on Board Logbook Fisheries Program, with registers *in situ*, of all the activities performed in a sample made from a group of purse-seiners, since the moment they sail until they return to landing port<sup>6</sup>. This Program contributes with valuable information on the different fishing effort measures, distribution of resources, behavior of schools, discarding, by-catch, and interaction with superior predators, among others.

At present, we count with 25 observers on board, strategically distributed in the main landing ports along the Peruvian littoral, and are installed in an aleatory way on board of the steel purse-seiners, wood (Vikings) and lower scale, industrial fleet (Fig. 1). The boarding of personnel is made permanently during the fishing seasons.

Due to the need of counting with information on real time, the observers onboard were awarded with mobile telephones with an application especially designed for them. The data is digitized in the mobile telephones within the fishing zone and are sent in an automatic way to the IMARSIS Data Base of IMARPE (Fig.2). The system has been performed in Java program language and is connected to the data base by http. Previously, digitations were performed in Excel calculus sheets, afterwards the charts were received in Headquarters, were consolidated and the information verified; this process took too long. This new system allows scientists to count with all the elements of an integrated computer system for the management of files and recuperation of information, allowing giving the pertinent recommendations more rapidly.



**Figure 2.** Process of sending the information obtained by the Fishing Logbook Program, on board of the purse-seiners fleet.

<sup>6</sup> Bouchon M, Ñiquen M, Arias M, Bello R. 1997. Manual de Operaciones del Proyecto Bitácoras de Pesca. Inf. Prog. IMARPE 74: 44 pp.

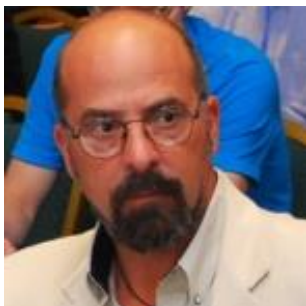
### Results/Discussion

According to the observations, the PBP is capable of generating valuable information on the biologic and population aspects of the Northern – Central Stock of the anchovy. References on the minimum sizes as well as the spatial and vertical distribution are able to be analyzed during almost all the month anchovy is fished.

At present, the administration of fishing resources in Perú is based in the incorporation of elements of the ecosystem focus. This innovation performed in an orderly and rapid way, has allowed the stability in the development of fisheries, assuring the sustainability of the resources through time, influencing its impact in all the periods, in short as well as long terms. Likewise, the greater biologic-fishing information obtained has allowed diversifying and increasing the management measures in the pelagic fishery.

The system allows taking more rapid protection measures of the stocks, especially in the case of having to apply a closing season due to the fulfillment of quotas and the high incidence of juveniles, closings determined geographic areas. The use of the data provided by the Logbook Program has allowed to now in real time the main areas of fishes and the area of incidence of the juveniles. On the other side, it has allowed to improve the monitoring in real time of one of the greatest fisheries of the world, where it has just been implemented a system of individual quotas has been implemented, same that is one of the keys of the success of this management systems.

### USING OBSERVER DATA AND SATELLITE MONITORING TO IMPROVE ESTIMATES OF FISHING EFFORT



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#### Introduction.

The common hake fishery (*Merluccius hubbsi*) is the most important fishery in the Argentine Sea. The offshore fleet operates primarily in the range of (34° S-48° S), although most exploitation takes place south of 41° S, from the inner shelf to the continental slope and is used by the freezing fresh fish vessels and processors which target common hake.

This fleet comprises 138 ships, with a length ranging from 20 m to 60 m, and an engine power from 290 HP to 2000 HP. These features are used to divide the fleet into the following strata:

Stratum I: Vessels that have a length between 20 m and 38 m and 290 HP and 699 HP.

Stratum II: Vessels that have a length between 25 m and 65 m and 700 HP and 899 HP.

Stratum III: Vessels that have a length between 32 m and 60 m and 900 HP and 1399 HP.

Stratum IV: Vessels that have a length between 41 m and 60 m and 1400 HP and 2000 HP<sup>1</sup>.

Data from fisheries observers are very accurate and sufficient to validate the daily catch rates due to the high coverage presented in strata III and IV, being super-optimal<sup>2</sup>. The objective pursued is to have observers covered with 7% of fishing trips, and this is achieved by giving a spatial and temporal coverage<sup>3</sup>. Therefore, observer's data are representative of both spatially and temporally.

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<sup>1</sup> Irusta, C. G., Castrucci, R. y Simonazzi, M. 2006. Desembarque, esfuerzo y CPUE derivados de la flota fresca argentina dirigida al recurso merluza localizado al norte de 41°S. Período 1986-2005. INIDEP. Inf. Téc. Int. 5/06:31pp.

<sup>2</sup> Ramos, A., Blanco, G., Aubone, A. y Rodríguez, J. 2011. Evaluación de la cobertura histórica del subprograma de observadores a bordo a la flota merluquera para los años 2007 y 2008. Informe de Investigación N°40/11:9pp.

<sup>3</sup> Aubone, A., Rodríguez, J., Blanco, G., Castañeda, F. y Cassanelli, M. 2009. Metodología para la estimación del número mínimo de observadores a bordo, necesarios para obtener una cobertura adecuada de la flota pesquera. INIDEP. Informe de Investigación N°69/09:10pp.

Fishing Vessels in Argentina, except for the artisanal fleet, are required to use marine transceivers with GPS (Global Positioning System) on board.

This paper aims to compare the data from the On-Board Observer INIDEP (National Institute of Fisheries Research and Development), the satellite monitoring system and fishing parties, in order to verify discrepancies or similarities observed between these three data sources, with respect to time and trawl hauls and thereby verify the performance of the fleet.

### Methods

The data used in this report came from trips with observers on board 18 ice trawlers, which were 44 trips in 2011. Logbooks Data and Satellite Monitoring Data were retrieved from SIOP (Information Fisheries Oceanography System INIDEP) and these Satellite Monitoring Data are provided by companies Sitrack, AEROTERRA MARINE, AND NAVALSTAR Globalstar.

We calculated the number of tows and duration (expressed in minutes) from 18 vessels and 12 ice trawlers belonging to Stratum III and 6 belonging to Stratum IV, who conducted 2549 commercial fishing hauls in a limited area (from 40° S to 42° S), in comparison to 38° S - 49° S and 52° W and the coast.

Satellite Monitoring data were selected from vessels whose speed ranged from 3 and 5 knots. Taking into account the towing speed of all vessels fishing trips in 2011, the result showed a minimum speed of 3.6 knots, a maximum speed of 4.4 and an average speed of 3.91 knots.

### Results / Discussion

The prediction equations of real minute fishing hauls, from logbooks data and satellite data are equal to:

For Statistical Square Data per Trip:

$$\hat{y}_{obs} = 82,34 + 0,99 \times y_{part}$$

$$\hat{y}_{obs} = 133,28 + 0,65 \times y_{sat}$$

For total data per Trip

$$\hat{y}_{obs} = 346,78 + 1,02 \times y_{part}$$

$$\hat{y}_{obs} = 453,35 + 0,68 \times y_{sat}$$

Table 1 shows the basic descriptive statistics of the distribution of the relative errors of prediction that relate the data entered in the logbook and the data determined by the satellite, with the data recorded by the observer. In the data table are considered by statistical squares corresponding to the same trip and total trip data.

Basic statistics	Per Statistical square		Per Trip	
	Logbook	Sat.	Logbook	Sat.
N	306	310	44	44
Mean	-4,28	-19,18	-1,81	-3,19
Standar Des.	58,68	68,81	25,16	19,85
Lower Lim (mean) 95%	-10,88	-26,87	-9,45	-9,22
Upper Lim(mean) 95%	2,32	-11,49	5,84	2,85
Mínimum	-666,07	-447,33	-130,99	-77,97
Máximum	77,18	93,86	89,24	42,17

**Table 1:** Basic descriptive statistics relative prediction errors obtained by jackknife procedure for logbook and the satellite in relation to the data recorded by the observer. Errors are considered for the data per statistical squares within each trip and total trip data.

### Conclusions

Data from fishing haul duration in minutes recorded by Satellite Monitoring overestimate the fishing haul duration in minutes recorded by observers, both within each statistical square trip to total trip.

**For Statistical Square Data per Trip:**

$$\hat{y}_{obs} = 133,28 + 0,65 \times y_{sat}$$

**For total data per Trip:**

$$\hat{y}_{obs} = 453,35 + 0,68 \times y_{sat}$$

The Satellite Monitoring raw data cannot be used without a proper calibration, as a substitute for real data recorded by the observer as the raw satellite data strongly overestimates the data of the observer. To transform values-satellite-observer values should be used the following prediction equations:

The average relative errors prediction considering Satellite Monitoring data and using previous prediction equations are equal to -19.18% for the data per statistical square within each trip and -3.19% for the total data trip.

Data from logbooks and according to the result of statistical analysis, data from tow duration in minutes registered on logbooks, would underestimate with a small bias from a practical point of view the observed data by the observer, but it should be noted the data used in this paper from logbooks are registered in "exact hours" and does not own a minute data associated with these values.

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## SCIENTIFIC OBSERVER DATA MANAGEMENT AND QUALITY ASSURANCE AT CCAMLR



Eric Appleyard  
CCAMLR, Australia.

The Commission for the Conservation of Antarctic Marine Living Resources is a multi-lateral organisation responsible for the conservation and management of the marine living resources and associated fisheries in the Southern Ocean. The fisheries are managed in a regulatory framework designed so that fishing does not expand faster than the acquisition of data necessary to ensure that each fishery meets CCAMLR's ecosystem based management objectives. CCAMLR's Scheme of International Scientific Observation was implemented to collect flag state independent scientific information to monitor the impact of fishing on the Antarctic ecosystem. The use of CCAMLR observers became compulsory in all finfish fisheries from 1994.

The Scheme operates internationally, with all observer data collected on standard forms and submitted to the CCAMLR Secretariat through designated technical coordinators for each Member. The development of standardised forms is essential for high quality data collection. The development and amendments to the logbook forms and data collection protocols are first discussed at the Scientific Committee's working group meetings and are then submitted annually to the Scientific Committee for endorsement. Once endorsed, the Secretariat updates the logbooks and distributes them to the all technical coordinators who are then responsible for distributing them to the observers. Technical coordinators play an important role in ensuring high observer data quality. This is done through training on data collection methods and sampling requirements, debriefing observers to identify any problems with the collection of data, checking the data before submitting it to CCAMLR and answering any data-related questions from the Secretariat arising from data quality assurance routines run on all submitted data.

All data submissions go through a series of pre-data entry checks, which look for field format issues, correct units have been used (kilograms not grams etc.) and the use of the correct CCAMLR codes for sex and maturity stages etc. The Secretariat also performs a series of statistical checks on the raw data to identify anomalies in length–frequency and length–weight data. During the data entry phase a series of automated validations take place, this covers conditional formatting and range checks (pre-defined length ranges for each species). Logical checks are performed to ensure area codes are cross referenced with recorded latitude and longitudes and that dates follow a logical sequence (hauling cannot commence before setting etc.). The database has a set of primary key constraints which ensure that key fields are not missing and that codes recorded by observers match those defined in the database (species and gear codes etc.).

To ensure that CCAMLR data is of the highest quality for scientists and managers to use, the Secretariat is always looking for ways of improving data quality. Some of the future developments are enhanced relation checking, using multiple fields like location and times to calculate distance and speed travelled to make sure these are operationally valid. The development of species distribution checks, using defined species specific parameters (distribution patterns and depth ranges) to verify that a correct species code has been recorded in an area is also under development. Like many organizations, this is a balance of managing expectations with current workloads.

#### *QUALITY MANAGEMENT SYSTEM ISO 9001, AS A TOOL TO IMPROVE DATA QUALITY MANAGEMENT AND FISHERIES OBSERVERS PROGRAMS. CASE STUDY: RESULTS SIX YEARS UNDER OPERATION IN IFOP.*



Guzmán, O.

Instituto de Fomento Pesquero, Chile.

In 2004 a group of scientists, engineers and technicians of the IFOP, began to develop a data management system assisted with information technology. The system became operational in 2007, and is in a process of continuous improvement. This development was carried out in parallel with the quality data management system ISO 9001. Both systems were presented at the 6th IFOMC. This workshop will present a scaling system throughout Chile. It has three modules: a) logical data entry, editing, storage and webcast. This includes fishing logbook data, catch composition and bycatch species; sampling length, proportion and sexual maturity, total and gutted weight, sample ID for otolith and stomachs samples. b) Data reception and storage, control and status of receiving data transmitted by each observer, timing control for each process, software for expert data validation and delivery to the scientists managing different fisheries monitoring programs. c) Automated assessment and webcasting of monitored fisheries biological indicators: cpue, average size, size composition by geographical area and sexual maturity.

## KNOWLEDGE, SKILLS, AND ABILITIES OF SCIENTIFIC OBSERVERS TO COLLECT QUALITY DATA: A CHALLENGING AND MULTIFACETED JOB



Ulloa, M., Bendel, G., Delgado, S., Villouta, C., Luna, N.  
Instituto de Fomento Pesquero, Chile.

The FAO (2010) states: “The fisheries are a socio-ecological system involving fishing operations and other policy areas, comprising the links established between people and the environment.” Scientific Fisheries Observers (FO), as part of a fishery system are involved in a turbulent interactions network within a much broader and complex socio-ecological system, where not only people are involved, but also aspects such as technological, legal, economic, political, territorial, local culture, organizations, social, family, institutional, environmental ethnicity, etc. The experience gained by FO in the Chilean fishing system will be shown as a study case in which we will explain: 1) different fisheries and its work environment, 2) the different tasks performed in each case and the difficulties faced and 3) the knowledge, competencies and skills they must have to collect quality data on the fishery system. All this in the context of the new Chilean Fisheries Law, which expands the scope and diversity of work to be performed by a FO. Since scientific fisheries observers are the first essential link in fisheries research for the sustainable management of resources, it is necessary to give the FO the status of key person. To achieve this recognition, political will is required to legally empower the FOs, to be treated and accepted with due respect by fishermen. This will enable FOs to capture the knowledge they have, and translate it to the context and meaning required by researchers.



7<sup>th</sup> IFOMC 2013  
Session presentations



# Observer Professionalism Workshop (OPW)

Session lead: Luis Cocas | Undersecretariat for Fisheries and Aquaculture, Chile.  
E-mail: [lcocas@subpesca.cl](mailto:lcocas@subpesca.cl)

## Objectives:

This session will first present the IFOMC series of historical perspectives and driving themes centered around observer professionalism, while providing background and status of the IFOMC's Observer Professionalism Working Group (OPWG). Secondly, panelists will discuss current trends and issues affecting observer professionalism.

## OPW Presenters

### OBSERVER PROFESSIONALISM THEMES



Davis, K

Observer, Observer Professionalism Working Group (OPWG) Chair.

#### Introduction

The collection of high quality information is essential to the sustainable management of aquatic living resources. Human observers are the most reliable and the only independent and scientifically-viable data collection source for many types of at-sea and dockside information. Consequently, the integrity of many data products from an observer programme is greatly dependent on the conduct, performance accountability, quality experience retention, support and morale of that program's observers<sup>1</sup>.

“An ‘observer’ is a person who is authorized by a regulatory authority to independently collect aquatic resource information in the field (either at sea or on shore) outside the authority of the monitored entity.”<sup>2</sup> According to this workshop, the Observer Professionalism Working Group (OPWG), the Association for Professional Observers (APO) and the International Observer Bill of Rights (IOBR) project, the term ‘observer’ includes all professions that fit into this definition; including (but not limited to) titles such as ‘Fisheries Observer,’ ‘Scientific Fisheries Observer,’ ‘Dockside Monitor,’ ‘Protected Species Observer,’ ‘Marine Mammal Observer,’ ‘MCS Observer,’ ‘At-Sea Monitor (ASM),’ ‘Sea-sampler,’ ‘Dockside Sampler,’ and ‘Fisheries Inspector.’ Observers should have financial interests independent from the interests of fishing industries; and, publications and monitoring programmes globally should guard from ever using the term ‘observer’ to describe “Industry Self-Monitors,” who do have financial dependency on industry. In order to do their jobs professionally, observers need (not an exhaustive list): clear and prioritized employment terms and rights (in written contract); evident responsibility expectations (codes of conduct) for all stakeholder entities involved in the fair, safe and healthy employment/deployment of observers; and, clear inter-stakeholder lines of communications (including grievance procedures), from employment start to observer data end-use.

*Observer Professionalism Themes* is a collection of resources that represents the OPWG work up to finalizing its Observer Professionalism Focused Interviews Project (OPFIP) in the context of the 6<sup>th</sup> IFOMC (2009)<sup>3</sup>.

<sup>1</sup> Davies, S. L. and J. E. Reynolds. 2002. Guidelines for developing an at-sea fishery observer programme. FAO Fish. Tech. Paper No. 414.:116 pp.

<sup>2</sup> See the International Observer Bill of Rights (IOBR) project in these proceedings and at [www.apo-observers.org](http://www.apo-observers.org), “Observer Professionalism and Rights.”

<sup>3</sup> NMFS. 2010. Proceedings of the 6th International Fisheries Observer and Monitoring Conference. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-107, 367 p. See pages 295-306: <http://spo.nmfs.noaa.gov/tm/TM107.pdf>

## Methods

The OPWG was founded in 2006, in the context of the IFOMC series, with the purpose of: investigating, categorizing, and prioritizing the international working knowledge of observer professionalism terms and observer rights initiatives; and, producing firmer conference outputs regarding this important topical area of worldwide observer and monitoring programmes. The OPWG greatly referenced the 2<sup>nd</sup> Conference's (St. John's, Newfoundland, 2000) Observer Bill of Rights (OBR) document<sup>4</sup> when shaping its founding goals; referenced this prelude to the 7<sup>th</sup> IFOMC's International Observer Bill of Rights (IOBR) project throughout all of its 5<sup>th</sup> and 6<sup>th</sup> Conference activities, and assisted with the drafting and editing of the IOBR and supporting Code of Conduct for Responsible Observer Programs - Observer Health and Safety (ROPHS) and Stakeholder Responsibilities (ROPSR)) documents - in the context of the 7<sup>th</sup> IFOMC.

For the 2009 OPFIP project, the OPWG (with 20 members) centered about collecting in-depth interviews from the four OPWG topical areas of study: 'Wages and Benefits,' 'Support and Opportunities', 'Employment Standards', and 'Social Equity.' The main project purpose was 'Outlining Avenues that Foster the Recruitment and Retention of a Professional, Equitably Employed Workforce of Observers.' To locate interview participants, OPWG members reached out among all of their networks and made announcements in the *Spring 2009 Mail Buoy*<sup>5</sup> and at the 6<sup>th</sup> IFOMC. Interviews were conducted by utilizing the following techniques: in person, on-line correspondence, telephone, or post. 74 interviewees (from many global observer programmes) completed 92 interviews, with approximately half of the interviews completed prior to the 6<sup>th</sup> IFOMC and half completed at or shortly thereafter the conference.

Digital transcripts of all OPFIP interviews were completed in 2011, and there is potential for living Observer Professionalism Themes resources to be extensive. These resources will continue be worked on long after the close of the 7<sup>th</sup> IFOMC.

## Results/Discussion

OPFIP identified topics/issues are organized in *Observer Professionalism Themes* resources according to the progression of observer employment from start to end:

- Employment: Recruitment and Hiring;
- Deployment Preparation;
- Deployment;
- Post Deployment;
- Employment Retention and Career Support;
- Observer Data End-Use;
- Feedback from Observers; and,
- Program Assessments and Harmonization.

Rather than analyzing what interviewees identified as professionalism issues and solutions, these resources are presented to exhibit the variety of perspectives shared (especially in the context of the OPFIP focused interviews, with other related background references). Stakeholders are encouraged to reference these resources according to their own investigations or interest and draw their own conclusions. These resources are meant to: exhibit a series of topics recognized to be of high importance to observer professionalism among global programmes; identify successful practices among programmes; address practices of concern; identify capacity building options, while addressing the practicality of programmes implementing strategies that could foster successful practices; and, ultimately lead stakeholders to resources and perspectives (interviews) to consider at their own discretion.

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<sup>4</sup> Anon. 2000. Canada - U.S. Fisheries Observer Program Workshop - Proceedings. NMFS and DFO, St. John's, Newfoundland, Canada. 52p. OBR document: [www.apo-observers.org/docs/ObserverBillofRights.pdf](http://www.apo-observers.org/docs/ObserverBillofRights.pdf)

<sup>5</sup> APO. 2009. Mail Buoy. Spring 2009; 12(1). A quarterly newsletter of the Association for Professional Observers (APO). Link: <http://www.apo-observers.org/mailbuoy/Spring09MB.pdf>

Without ever identifying interviewees to a personal level, interview response is defined according to classifications such as: stakeholder perspective, gender, ethnicity, experience, and region/country/programme. Observer professionalism Themes outputs carry no assumptions of the degree of responsibility each stakeholder within an observer programme (e.g. Regulatory Authority, Observer Programme, Observer Employer, Monitored Entity, Observer) would have in ensuring observer professionalism. The OPWG recommends following the Articles and Sections of the International Observer Bill of Rights (IOBR) and supporting ROPHS and ROPSR documents closely in accordance with all Observer Professionalism Themes outputs.

**‘Observer Professionalism Themes’ on-line Resources:**

To review all public Observer Professionalism Themes resources (like the Observer Profession Glossary) and other OPWG resources or to provide feedback in regards to the continued work of the OPWG please navigate to OPWG web resources: <http://www.apo-observers.org/ifomc/opwg.php>

**Point of Contact:**

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**Acknowledgments**

We’d like to thank the 7<sup>th</sup> IFOMC organizers for making the Observer Professionalism and Rights Workshop possible. And, these resources could not have been possible without the help of the 25+ OPWG members (since foundation) and the 100+ observers and Conference delegates who have contributed to this work - Thank you!

*ISOLATING VARIABLES THAT CONTRIBUTE TO INCREASED OBSERVER RETENTION*

Barto, A.

East West Technical Services LLC, USA.

The purpose of this discussion is to increase cost efficiency and data quality by reducing the relative attrition of at-sea monitors. The high initial investment of observer training paired with the low statistical value of data produced by probationary monitors signifies a field throughout the employment process in need of reform. Further, increased observer retention will proliferate a more positive relationship between and amongst participating stakeholders, i.e. fishermen and their respective management agency. This dialogue will explore options such as a survey to the aforementioned stakeholders and an open conversation amongst management agencies. The survey could include a series of check-all-that apply characteristics such as age, sex, education level, socioeconomic back round, work history, etc. and will resemble those of a detailed resume. The survey could also include a series of scaled, 1-10 characteristics. These will be less tangible and will include work ethic, time management skills, physical ability, safety, and overall performance. Survey data from both stakeholders can then be correlated to observers that keep and maintain their employment. Interagency communication could also isolate factors that contribute to prolonged observer employment and performance. The anticipated results of this discussion are objective characteristics that statistically increase the likelihood of observer retention. Moreover, this objective data can also be a mechanism to maintain accountability for said observer’s performance. This data can then be used as a criterion for choosing qualified applicants.

## THE VULNERABILITY OF OBSERVERS WORKING AS “AT WILL” CONTRACTED EMPLOYEES

Mitchell, E.

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### Introduction

Outsourcing of observer employer (sometimes called “observer provider”) services is increasingly becoming the norm in federal fisheries observer programs around the world. Observers find themselves beholden to two bosses. On the one hand the government agency is their boss: the agency mandates observer coverage, dictates the observers' duties, evaluates the observers' performance and often have hiring and firing standards required of observer employers. Yet, on the other hand, the private company is legally responsible for the observers' welfare and sometimes this can result in observers finding themselves in limbo with no job security and no grievance procedures.

### Case Study

The case study I am about to present highlights the vulnerability that many observers face under contract employment, and involved mismanagement at multiple levels. The National Marine Fisheries Service (NMFS) Pelagic Observer Program (POP) in the Southeast of the United States fired a highly qualified observer for writing an e-mail to program managers, asking them why the agency wasn't enforcing rules meant to protect observers. The following day he was told by his employer, IAP Worldwide Services, which contracts with NMFS to provide observer services, informed them that he was no longer to work in that program. Neither NMFS, nor the employer, gave him a reason for this, nor did they have any evidence against him to support their decision. He was simply told by his employer that their client, NMFS, didn't need an excuse, only that they didn't want him back. So, technically, he wasn't fired by NMFS. He wasn't told he did anything wrong. He wasn't fired by his employer. He was simply prevented from working again in that program.

He subsequently reported this to the National Observer Program (NOP)<sup>1</sup> which coordinates observer program management nationally, with a statement that included claims of mismanagement by multiple programs in the Southeast region. He reported they were ignoring observer reports of fisheries violations, and telling observers to ignore marine pollution violations. This was corroborated by multiple observers who we subsequently interviewed. After this statement, he was informed by his employers that he was banned from working with the entire region's programs. In spite of his reports of having witnessed several fisheries violations, to this day he has not been interviewed by NMFS enforcement nor told the reasons for the disciplinary actions against him.

Upon interviewing several observers, many were apprehensive about coming forward, saying they were fearful of losing their job. Observers in this region were reportedly pressured to accept unsafe vessel assignments during the BP oil spill. One observer reported that because so many of the vessel assignments violate the equal accommodation law, if they refused every vessel that violated this law, they feared they would lose their job. Another observer came forward and said that he spoke for 12 observers who were too scared to come forward and would only come forward with their stories if they could be guaranteed anonymity through a lawyer. In my view this encompasses a hostile work environment. In this situation, nobody was held accountable. Contracted employees in any sector have no whistleblower rights in the United States. Because NMFS was not the employer of the observer, their laws regarding official complaints did not apply to the observer.

### Discussion

The government agency has a moral obligation to support its observers, regardless of who actually pays the observer. Observers form a critical function in the government's ability to objectively manage public fisheries resources. The unbiased data that observers collect allows the government to make scientifically-based objective decisions. Instead of treating observers as their own, the work is often marginalized by all sectors. Instead of guaranteeing their rights and supporting them, there is an expectation that observers will put up with the harsh treatment.

### Conclusion

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<sup>1</sup> Statement by Jonathan Lee Combs. 2011. [http://www.apo-observers.org/docs/Statement\\_by\\_Jonathan\\_Lee\\_Comb\\_sent\\_to\\_APO.pdf](http://www.apo-observers.org/docs/Statement_by_Jonathan_Lee_Comb_sent_to_APO.pdf)

Governments have the power to make the observer employer support the observer to do their job with integrity. They must require fair labor standards in the contract between the government and the employer and place conditions based on annual compliance reviews that include reports from observers. Without grievance procedures independent of the agency and the employer, observers are vulnerable to being fired without cause. Without agency support of its observers, regardless of who actually employs them, conflicts of interest, favoritism, discrimination, and collusion with the fishing industry have the potential to influence decision-making of observer placement and treatment.

Observers must have a venue to lodge formal complaints without negative repercussions. Otherwise the power of the program managers and employers remains unchecked. The fallout from this is an erosion of observers' rights, which eventually leads to attrition of qualified observers. This compromises the quality of the data and adds to observer program costs. Those who stay may compromise their own rights to stay in good standing. Observers shouldn't have to make this decision. If there are laws to protect them, the observer should know about them and expect that they will be enforced.

An observer cannot long defend the integrity of a program or maintain the illusion of representing the government, if they are not supported. If there are no protocols that hold everyone accountable for the integrity of observer programs, the quality of the data may be compromised. The observer supports the agency's ability to defend its scientifically-based decisions. They are well aware of the many pressures against this. But in order to do this, there must be mutual support and respect in order to carry out these objectives.

## *EDUCATING CREW MEMBERS: THE OBSERVER ROLE*

Fader, J.

Saltwater Inc.; Pacific Island Regional Observer Program, National Marine Fisheries Service.

### **Introduction**

This presentation considered additional roles that observers could take on pelagic longline vessels covered by the Pacific Islands Regional Observer Program, as well as basic principles for how observers could be used in a more cost-effective and goal-oriented manner in any observer program. While captains of fishing vessels are ultimately responsible for staying up to date on current regulations, documenting catch and bycatch, and the proper handling of protected species interactions, these responsibilities often fall on crewmembers in the Hawaii longline fleet as captains are frequently not present on deck during actual fishing operations. Rarely, however, do the captain and crew speak the same language, and crewmen are commonly misinformed, or not informed at all, about regulations, fish identification, and what to do if a protected or endangered species is hooked or entangled.

These miscommunications are generally mitigated when fisheries observers are present on a vessel. Observers are well trained in safety, species identification, protected species handling, and current laws and can assist captains and crew in complying with these regulations and meeting the goals of the observer program. Unfortunately, many observer programs are not able to cover 100% of registered fishing trips and thus do not have the advantage of observer presence for meeting program goals during all fishing operations. This presentation discussed simple actions that fisheries observers could do during deployment to help advance observer program goals and increase compliance with fishing regulations on later trips when observers may not be present.

### **Methods**

The pelagic longline observer program in Hawaii was discussed as a model for assisting captain and crew in meeting observer program goals. In this fishery, observers work closely with the crew and can provide hands-on training in species identification, protected species handling, as well as briefings or reviews of safety training. Observers could provide documentation to leave behind after the trip, updates on regulations, species

identification guides, etc. This would be especially beneficial on deep-set (Tuna) trips as they currently receive 20% observer coverage.

### Conclusions

Increasing the knowledge base of the crew could be a major step in increasing the effectiveness of observer programs with less than 100 percent coverage. Possible steps that observers could do while deployed on an observed fishing trip were discussed. These steps were specific to the Hawaii longline fleet but general principles were mentioned that are broadly applicable to other observer programs. With the amount of time that observers spend with captain and crew in some fisheries, there is a great opportunity to increase the knowledge and skills that are ultimately required for sustainable and well-regulated fisheries.

There was one comment from the audience emphasizing that observers themselves do not have the authority to independently implement additional policies or training programs. This was not specifically addressed in the presentation, however, the ideas presented here are not intended to be assumed by observers without proper training and full implementation by an observer program. The steps suggested would need to be officially recognized by the observer program and included in training programs.

## WHAT IS THE RELATIONSHIP BETWEEN OBSERVER EXPERIENCE AND DATA QUALITY?



Brander, D.  
NOAA/NMFS, USA.

What is the relationship between observer experience and data quality? It seems intuitive that the quality of data collected by a fisheries observer would improve as the individual gained experience. In the Northeastern United States, there are a number of observer and monitoring programs, two of which have measures in place to evaluate observer performance and data quality. These two programs include NEFOP (Northeast Fisheries Observer Program) and the ASM (At Sea Monitoring) program. NEFOP has been in place since 1989 and covers a large number of fisheries, including groundfish, scallop, squid, surf clam and ocean quahog. This program also covers many different gear types including trawl, dredge, trap, long-line, and gillnet. Those trained in the service of this program are referred to as observers. The ASM program was instituted in May of 2010, for the purpose of covering the federally managed New England multispecies fishery, which is targeted by vessels in the Northeast Groundfish Sectors (a newer catch share program). The gear types covered in this program include trawl, long-line, and gillnet. Those trained in the service of this program are referred to as monitors. While there is overlap in the geographic areas, fisheries, vessels, and gear types, there are important differences that distinguish the two programs. For example, in addition to being trained in the broader range of fisheries and gear types mentioned, NEFOP observers collect much more detailed information on fishing gear characteristics, biological samples from target and priority species, and they may collect samples from or retain whole specimens from incidental takes. Many people have dual certifications and participate in both of these programs. The evaluation system in place is used to assess individual observers and monitors' work performance. These evaluations are conducted biannually. In this study, the biannual reviews for observers, monitors, and dual-certifications (observer vs. monitor) were averaged on an annual basis and plotted on a multi-year basis. Then, several experience categories were identified and compared. The scoring in these evaluations definitively show that a positive correlation exists between length of service as an observer or monitor and improved data quality. Observer and monitor evaluation data from 2007 and 2010, respectively, to present, are included in this investigation.

## ESTABLISHING A COLLABORATIVE NETWORK LINKING FISHERIES OBSERVERS WITH AGENCY/INSTITUTIONAL SCIENTISTS



Dietrich, K.,<sup>1</sup>, Mitchell, E.,<sup>2</sup>

<sup>1</sup> Fisheries Consultant, USA.

<sup>2</sup> Association for Professional Observers, USA.

Fisheries-dependent data collected by scientific observers is utilized by a wide range of people. Observers are an underutilized resource for agency or institutional staff using this data. Currently, there is no formal mechanism whereby observers who are interested in research can work directly with scientists and other data users in their field of interest.

Observers are the next generation of fisheries scientists – they need positive mentors and strong role models. Linking observers with data users is not a new concept. In fact, a similar concept was presented at the 5th IFOMC relating to increased collaboration between observer programs and the various Sea Grant programs that provide a marine extension service through public universities<sup>1</sup>. Linking observers with data users to enhance professional development needs to be institutionalized by observer programs.

A formalized network would benefit observers, data end users, the public and the resource. Potential benefits include:

- Increased observer morale which in turn may encourage higher retention;
- Increased pride to be associated with the observer program and improved data collection quality;
- Provide an opportunity to perform analyses and contribute to publications;
- Establishes a vehicle to mentor future fisheries scientists and managers; and
- Increased understanding of data limitations by scientists (and data end users).

There are a variety of options to implement a formal network such as social media, a web-based database linking keywords with contact information, a formal mentorship program similar to the structure used by the American Fisheries Society and likely a host of other venues.

Observer-scientist collaborations exist but they are usually the exception rather than the rule. Examples include: 1) the collaboration of an observer, the U.S. National Marine Fisheries Service, U.S. Fish and Wildlife Service and the fishing industry to develop an albatross identification placard to be used by Alaska groundfish fisheries observers as well as the fishing industry; 2) Projeto Albatroz in Brazil focuses on the reduction of seabird and sea turtle bycatch. Many observers were also graduate students and their work was somewhat collaborative with fishers. These observers collected and analyzed the data and published results in peer reviewed journals<sup>2</sup>.

Carrying out this concept is not without a few hurdles. In a few countries, there is legislation relating to data confidentiality. Access to the raw data is not impossible but does involve additional steps to gain legal access. There may also be issues regarding who should make initial contact – observers or the data users. Finally, some programs already have a process in place. We are not trying to subvert any existing processes; rather we encourage much more interaction between and among observers and the data users. We encourage all delegates to help foster more collaboration between observers and data users in the future.

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<sup>1</sup> Dietrich, K. 2007. Sea Grant and observer programs: opportunities for future cooperation. In: McVea, T.A and Kennelly, S.J. (ed.), 2007. Proceedings of the 5th International Fisheries Observer Conference – 15 – 18 May 2007, Victoria, British Columbia, Canada. NSW Department of Primary Industries, Cronulla Fisheries Research Centre of Excellence, Cronulla, Australia, 412 pp. ISBN 978 0 7347 1861 7.

<sup>2</sup> Bugoni, L. P.L. Mancini, D.S. Monteiro, L. Nascimento, and T.S. Neves. 2008. Seabird bycatch in the Brazilian pelagic longline fishery and a review of capture rates in the southwestern Atlantic Ocean. *Endangered Species Research* 5:doi: 10.3354/esr00115; Bugoni, L., T.S. Neves, N.O. Leite Jr., D. Carvalho, G. Sales, R. W. Furness, C. E. Stein, F.V. Peppes, B.B. Giffoni, and D.S. Monteiro. 2008. Potential bycatch of seabirds and turtles in hook-and-line fisheries of the Itaipava Fleet, Brazil. *Fisheries Research* 90: 217-224.







# POSTERS

## *ECONOMICAL DETECTION OF GEOGRAPHICAL ANOMALIES IN FISHERY DATA USING GIS AND ORACLE*

Moon, M., Stevenson, D.  
NOAA/NMFS, USA.

The North Pacific Groundfish Observer Program (NPGOP) maintains an extensive Oracle database that houses all biological data collected by groundfish biologists (observers) onboard fishing vessels operating in Alaska's federal exclusive economic zone (EEZ). One of the most persistent data quality issues faced by the program is the detection of species identification errors (outliers). Early detection of outliers greatly reduces the staff time required for post-field data editing, and increases the overall quality of the data. However, due to the sheer quantity of data collected by biologists in the field, it is cost prohibitive and unrealistic for staff to check species composition data for potential geographic outliers in real time. In 2009, NPGOP developed a GIS model to automate much of this process, providing a low-cost and efficient method of outlier detection for in-season species composition data. Currently we are attempting to refine the process with the goals of further reducing costs while continuing to improve data quality. Our initial approach to systematically checking all real-time observer species composition records for geographic outliers has been to extract records from the Oracle database and import them into ArcGIS. The GIS model is used to filter the through 93 species polygons of various fishes and crabs created using historical fishery-dependent and fishery independent data. The GIS model isolates outliers and computes their distance from the boundary of the range polygon. Outlier layers are then exported to a spreadsheet and disseminated to data processing staff for follow-up. To facilitate the process of detecting outliers, increase the frequency of updates, increase the availability of the outlier information to data processors, and decrease staff time in the creation of the outliers GIS layers and spreadsheet, we have begun integrating species range polygons directly into Oracle. We used Oracle Spatial Data Option (SDO) to import an ArcGIS layer containing 93 species polygons into Oracle as a table. The table produced is used to determine outliers within Oracle, eliminating the time needed for importing and exporting data to and from Oracle into ArcGIS. Initial queries run on the SDO table indicate Oracle is able to isolate outliers in 2.5 minutes for a typical size data set. Our next steps are to streamline the process by allowing data processors to generate outlier reports on demand from within the Oracle environment, and then to include additional information with the outlier reports.

## *ESTIMATING DISCARD WHEN A DISCARD BAN IS ENFORCED*

Huse, I.  
NOAA/NMFS, USA.

A discard ban, together with proper enforcement at sea, as well as technical regulations like selectivity devices, minimum legal size (MLS) and closed areas, can be effective in reducing discards. In Norway a discard ban on commercially important species was introduced in 1988, and followed by several other regulations intended to avoid bycatch. Despite having a discard ban, some discarding is likely, i.e. non-commercial species, target species with sizes below MLS and poor-quality individuals. Also illegal discarding of target species due to quota overfishing, high-grading or shortage of bulk capacity can occur. With a ban, discards may be difficult to estimate. The Reference Fleet is a small group of Norwegian offshore and coastal fishing vessels that are contracted to provide the Institute of Marine Research with detailed information about their fishing activity and catches on a regular basis. They regularly measure and register all their catch, including bycatch. In this work we study selected Norwegian fisheries in the North Sea. The reference fleet data giving the entire catch are compared with sale slips and other available data sources, to look at which species that are discarded (gillnet fishery) or sampling quality ashore (industrial fishery).

## THE 2013 ALASKAN OBSERVER PROGRAM BY THE NUMBERS

Faunce, C.  
NOAA/ NMFS, USA.

Observers in the North Pacific provide a variety of support services towards sustainable fisheries. Perhaps the most fundamental of these is the least appreciated, i.e. improved quality assurance on the identity, location, and disposition of fisheries catch compared to industry 'self-reported' sources. Changing how observers are deployed into the Alaskan fishing fleet has been a focus of the Alaska Fisheries Science Center and the Alaska Regional Office since 1992. The switch from a deployment system whereby fishers decide which events are observed to one where such decisions are under Agency control requires the development of observer contracts, a scientific deployment plan, programming infrastructure, outreach efforts and regulations. This poster depicts the quantities of individual elements that together comprise the most recent effort to 'restructure' the North Pacific Groundfish (and Halibut) Observer Program that began in April 2010 and is expected to be implemented in 2013.

## Session 2

### ITQ. SHARING DATA FROM INDUSTRY AND OBSERVER PROGRAMS, FOUR CASE STUDIES.

Bertolotti M.I., Blanco, G.  
INIDEP, Argentina.

The Argentine fishery system is complex and multidimensional considering the different fishing methods, the diversity of target and the various business strategies of organization and integration of production stages. The Federal Fisheries Law No. 24,922 established in Argentina Regime Capture Individual Transferable Quotas (ITQs) in which the Capture Individual Transferable Quota (CITC) is a temporary concession (15 years) of the State in favor of the holder a fishing permit, which enables the capture of a percentage of the Total Allowable Catch (TAC) of a given species and whose magnitude, expressed in tons, is established each year according to the CMP. The CITC are divisible and transferable, wholly or partially, either permanently or temporarily. The compliance regime for the ITQ management is an essential tool for understanding the dynamics of the sector, in complex scenarios with varying access to relevant information. One source of information is available from the Observer Program INIDEP, in addition to biological data the data allows for updating some social variables (employment), economic (cost structure) and technological (fishing capacity and intensity). The aim of this paper is to analyze the scope and usefulness of the information collected by observers: a) to contrast with the data reported by the companies fishing the national statistical system and other direct sources, ad hoc surveys, b) to contribute to knowledge of the causes of management adherence rate for species cuotificadas: Polish (*Micromesistius australis*), Patagonian toothfish (*Dissostichus eleginoides*), hoki (*Macruronus magellanicus*) and hake (*Merluccius hubbsi*).

## *BREAKING DOWN BARRIERS TO FACILITATE MSC CERTIFICATION PROCESSES: THE ARGENTINEAN CERTIFIED HOKI FISHERY AS A CASE STUDY*

Blanco, G. <sup>1</sup>, Favero, M. <sup>2</sup>, Tamini, L. <sup>3</sup>

<sup>1</sup> INIDEP, Argentina.

<sup>2</sup> UNMDP, Argentina.

<sup>3</sup> AA/AOP, Argentina.

The Marine Stewardship Council (MSC) has established a series of principles and criteria for sustainable fisheries, which are used as a standard to guide independent certification schemes. Those fisheries that meet these principles and criteria are eligible for certification. The complete evaluation is conducted by a team of international experts who analyze a given fishery in accordance with MSC Principles and Criteria by using key indicators for each component of the evaluation. The reports are periodically reviewed by a panel of external experts. A procedure for objections to the certification at different stages of the process is included in the system. Certification is granted upon approval of the assessment; the certification agent issues the MSC Certified Sustainable Fishery. The action plan aims to meet the conditions necessary for certification; if the fishery gets a score less than 80 (out of 100) points in any indicator during the evaluation process, then a series of actions should be agreed upon with the certifier in order to address the identified issues. Our project described in this paper is aimed to build capacities within the fishing industry by (1) developing a common and integrated view in different stakeholders including the fishing industry, the government and the civil society, and (2) facilitating the effective implementation of the certification action plan and extant regulations. Key actions to achieve this are breaking down barriers between sectors having different approaches and views on these fisheries issues, as well as opening channels of communication and understanding. Our initiative proposes a series of formal and informal meetings with the crews of fishing vessels where different aspects of the certification process and the most critical components of the action plan are addressed. The academia, NGOs and government through the National Fisheries Institute Observer Program are acting components in this project. The meetings include presentations and interactive activities to promote the exchange of information of all attendees, raising awareness, building confidence and strengthening the links between participants. The agenda for these meetings is focused in Principle 2 of the certification process which deals with the mitigation of the impact of fisheries on the environment. The proposed actions also include the facilitation of processes to implement mitigation measures to minimize by-catch in fisheries and to promote the adoption of best fishing practices related to the management of fish waste and bycatch. Meetings also allow the identification of partners which could further improve the spreading of information. Experience shows that skippers can play a relevant role in finding alternative and feasible ways of responsible fishing, creating win-win situations for the industry and the environment.

## *SUSTAINABLE FINANCING OF FISHERIES OBSERVERS: THE CASE OF CHUBUT, IN THE ARGENTINEAN PATAGONIA*

Caille, G. <sup>1, 3</sup>, Góngora, M.E. <sup>2</sup>, Soutric, M. <sup>2</sup>, Bovcon, N. <sup>1</sup>, Cochia, P. <sup>1</sup>,  
Mendía, L. <sup>1</sup>, Arias, C. <sup>1</sup>.

<sup>1</sup> Faculty of Natural Sciences of the Universidad Nacional de la Patagonia (UNPSJB), Argentina.

<sup>2</sup> Secretariat of Fisheries of the province of Chubut, Argentina.

<sup>3</sup> Project ISCMPA (ARG/10/G47 GEF - UNDP), Fundación Patagonia Natural, Argentina.

In the framework of the agreement between the Government of the province of Chubut and the National University of the Patagonia San Juan Bosco (UNPSJB), approved by Act VII No. 12 (formerly Law No. 2447) in 1984; and through successive "Work Agreements", signed between provincial Fisheries Secretary and the Faculty of Natural Sciences of the UNPSJB, since the year 2000, technical assistance to the "Program of Observers to Board" of the Chubut province" (POBCh) is being provided. Funding is provided entirely by the provincial government from its participation in the National Fund of Fishing (FONAPE, created by law in 1988), and has allowed providing operational and technical continuity to the activities of the POBCh for more than ten years. Objectives ranged from the creation of a "provincial fishery observer program", to be implemented within the framework of the national law No. 24.922 (Federal Fisheries law) enacted in 1998, which granted jurisdiction and domain on fishery resources to provinces with coastline in inland waters and the Argentine Territorial Sea adjacent to its coasts, up to 12 nm

measured from baselines given by the law No. 23.968 (1991) training and ongoing training of observers, work on board of the main fleets operating on provincial jurisdiction up to the oversight of the technical quality of their performance. The observers of the POBCh takes direct information on fishing operations and gears; on catches and environmental characteristics; on targets species and on selected biological aspects (species composition, bycatch of marine fauna and discards). Samples are also taken and observers collaborate with academic and scientific organizations. In the framework of funded agreements more than 200 observers have been trained, about 40 (20% retention) are currently active, and have been incorporated into the stable staff of the POBCh, ensuring resources to cover near to 10% of the activity of the main fleets in the provincial fisheries. The POBCh conceives fishing from an ecosystem approach which includes the fishermen and allowed to contribute to the knowledge of the region's coastal-marine biodiversity. With more than ten years of work, the POBCh is a provincial program consolidated in its funding; however, there is a need to be re-valued by the fishing sector, to analyze the viability of their contributions, and improve the technical quality of their performance in particular subjects, to ensure an effective contribution to the management objectives of provincial fisheries enforcement authorities.

## Session 3a

### *ELECTRONIC MONITORING TECHNOLOGY IN THE SOUTHEASTERN UNITED STATES COMMERCIAL REEF FISH AND SHRIMP FISHERY*

Loefflad, M.

National Marine Fisheries Service, USA.

There are several trends in fisheries management, government, and society influencing the development and design of groundfish monitoring programs in Alaska. We see an ongoing and increasing demand for rapid access to high quality information and application of that information to finer scales for management. In government, we are experiencing a decline in the financial resources allotted to the fisheries management enterprise due to an overall decline in government funding during challenging economic times. In society, we see continued rapid advancement of technologies that can be used in information gathering, transmission, quality control, analysis, and distribution, with broad acceptance of these tools. As demand for information increases and fiscal resources decline, we ask if we can do more with less? Meeting that challenge may be possible through the use of technologies. Deciding when to invest in any given technology can be challenging. Initial technology investments can be expensive and the investment represents a strategic monitoring choice which will have downstream consequences. For example, in the mid-90's computer technologies were changing so rapidly that some investments in laptop computers were obsolete before the tools could be deployed in the field. In contrast, an agency investment in Oracle database technology was made at a time when that tool appeared to be robust and ready to meet the demands for many years. Ongoing investment in this tool has enabled exceptional advancements in data storage, retrieval, integration and sharing across our agency. Technology applied to monitoring can have a downside. As catch share programs focus accountability at a fine scale, they can also provide incentives to subvert the monitoring program. NMFS in Alaska adopted the use of flow scale technologies to obtain catch weights on large catcher processors as the technology is highly reliable, very precise, and unbiased when correctly maintained. Our enforcement group recently cited a vessel for tampering with the scale to bias the catch weights. Lesson learned: electronic monitoring technologies can be tampered with, and management controls need to be designed in to the systems to detect and allow correction of subversive activities. Electronic monitoring via cameras (EM) has been identified as a potential cost saving tool for some applications, and is adopted in Western Canada as a production tool to audit logbooks, which form the primary basis for management decision-making. Application of this EM/audit model in U.S. systems has not occurred. However, camera technology has been applied in other ways in some Alaskan applications. There are also ongoing efforts to assess and advance the use of cameras to be used as a supplement to observers. An ongoing project in Alaska highlights EM challenges and technical advancements.

## *EVALUATION OF ELECTRONIC MONITORING AS A TOOL TO QUANTIFY CATCH IN A MULTISPECIES REEF FISH FISHERY*

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The South Atlantic snapper-grouper commercial fishery includes 73 species caught primarily with multiple sets of vertical hook and line gear on each vessel. Many of the species have low annual catch limits which makes management difficult. Self-reported logbooks are the primary data source for the fishery, although observers have occasionally been used to provide independent accounts of retained and discarded catch. The overall objective of this research is to determine if electronic monitoring (EM) technology can be used to fill data gaps within the fishery. EM is an onboard system that collects fisheries data using a series of sensors (drum, hydraulic pressure, GPS) and video cameras installed throughout a fishing vessel along with a user interface in the wheelhouse. Data collection is followed by post-fishing trip data interpretation and analysis. In this pilot study, EM systems were deployed on four vessels in 2010. The EM data collected were then compared to detailed catch data (species identification, disposition and count) recorded by an observer during 315 events recorded during 26 days at sea onboard 4 vessels. A total of 2,796 individual catch items were counted by the observer with 90% of those also recorded by the EM viewer. Mean catch counts from EM were on average less than observer counts for most observer count categories. Agreement between the EM reviewer and the observer was high for retained catch items, but considerably lower for discarded catch items (15% of total). The observer assigned catch to 17 families and 58 species. Species identification with EM was less accurate than catch recorded by the observer. The 3 most abundant species (vermillion snapper, black sea bass and gray triggerfish) comprised 66% of the catch and were successfully classified by the EM reviewer 89%, 52% and 87% of the time, respectively. The results indicate that EM monitoring has the potential to augment existing data collection programs in this and similar fisheries provided that species-specific enumeration and identification can be improved. Application of EM to this type of fishery would likely be enhanced if catch handling guidelines could be implemented to facilitate EM review.

## *ELECTRONIC MONITORING: NEW DEMANDS /NEW TECHNOLOGIES / REMAINING CHALLENGES*

Carovano, K., Munro, N., Carroll, T.  
Saltwater Inc., Alaska, USA.

Saltwater Inc. has provided fishery observers along the U.S. Pacific coast for the past 25 years. Recently, the amount of data needed to manage these fisheries has increased - both because of new catch share programs and the demand for data from smaller boats. Increased data needs have resulted in increased observer coverage requirements. As observer requirements have grown, so has the industry's demand for alternatives to on-board observers. This is particularly true for smaller boats where placing observers on-board is more difficult, disruptive, and expensive. Simultaneously, new technology has opened new possibilities. In response to these trends, Saltwater is working with fishermen's groups to re-imagine and field test new fishery monitoring technology. Test Case-West Coast Groundfish Trawl Fishery: Catch shares were introduced to this fishery in 2011 along with a new requirement for 100% at-sea observer coverage and 100% monitoring of landings. Fishermen approached Saltwater to develop an onboard digital camera system that could capture discard events and record high quality images of catch. Implementation Issues: High quality digital images allow human viewers to more accurately identify catch and are critical to fish identification software. The level of identification possible is a trade-off involving handling procedures that address the limits of space, time and personnel on small boats; retention requirements; and the use of dockside monitors. Alaska Longline Fishery: Starting in 2013 small longline boats fishing off Alaska are required to carry observers for the first time. Saltwater is collaborating with an Alaskan fishermen's group to define alternatives. Implementation Issues: We are field-testing new cameras, sensors, and event triggers. The review process utilizes open source software. Alaska Small Boat Fleet: The National Marine Fisheries Service (NMFS) recently awarded Saltwater Inc. a contract to install electronic monitoring systems on small longline boats fishing in Alaska. Implementation Issues:

Saltwater will collaborate with NMFS and fishermen toward full implementation including the installation of camera systems on up to 60 boats/year, recording all fishing events, providing high quality images to allow for accurate hook counts and fish ID. We will establish the installation and maintenance infrastructure needed for full implementation. Efficient coverage plans will need to consider the ‘observer effect’ and cost of installation and removal in remote locations. In conclusion, there are two trends - the increasing demand for data and new developments in technology - are opening the doors to new ways of collecting fishery data. Full implementation of new monitoring technologies will require new thinking about data needs, deployment strategies, handling protocols, retention requirements, vessel record keeping, the role of shoreside monitoring, and data review processes.

## *BRINGING EM INTO NEW FISHERIES THROUGH COST TRANSPARENCY AND MULTILEVEL DIALOGUE*

Barney, A.J.  
Ecotrust, Canada.

Developing and implementing electronic monitoring systems continues to be challenging across North America and globally. Much of the resistance comes from individual fishermen not wanting to take on high upfront hardware and software installation costs and/or lack of confidence in the system’s ability to deliver quality data. Ecotrust Canada is currently tackling both of these challenges in the development of our EM systems and in the delivery of monitoring programs. Ecotrust Canada is an enterprising nonprofit whose purpose is to build the conservation economy in coastal BC. As part of our mandate, EC supports community-built solutions that result in more sustainable fisheries for both the health of the resource, as well as the harvesters and communities that rely on it. We provide services and support for communities, First Nations, and enterprises within coastal and rural BC, with the expressed intent of enabling capacity building and expertise at the local level. As a non-profit operating in service provision and technology development we can offer lower costs to fisheries, and with our mandated work in community economic development and stakeholder engagement in decision making we have been able to better communicate the utility and economic benefits of EM to resource users. Creating dialogue with harvesters and working with them to design systems that meet their needs and those of resource managers and/or fisheries scientists helps to build trust in the monitoring capabilities and in data delivery. Creating this dialogue also helps users understand the costs associated with system development. Our use of Open Source software furthers reduces costs and allows another channel through which harvesters and resource managers can become engaged with the development of EM systems. This paper talks about our successes in creating interest in EM and generating development discussions in new fisheries.

## *ELECTRONIC MONITORING*

Blass, L.  
NMFS/ SEFSC, USA.

Electronic fisheries monitoring is quickly gaining popularity with management agencies due to ease of use and financial considerations. However, as electronic monitoring (EM) becomes more widespread, problems and limitations inherent to its use become more apparent. Electronic monitoring has several advantages when compared to traditional fisheries observing. One of the biggest advantages is cost, with EM generally being touted as substantially cheaper to implement. For instance, one study of the U.S. West Coast Groundfish program found EM to cost an average of \$200.00 per sea day, as opposed to a range of between \$365.00-425.00 for traditional fisheries observation (Environmental Defense Fund, 2012). Other advantages of electronic monitoring include suitability to a wider range of vessels, “24/7” uninterrupted data collection, and total objectivity of the data that is collected. Additionally, electronic monitoring eliminates the need for expensive training of observers, as well as reducing liabilities associated with fisheries monitoring programs. However, electronic monitoring is not without its own set of weaknesses and problematic considerations. One of the biggest shortcomings of EM is the utter lack of sampling capability. Also questionable is the capability to monitor areas outside of the immediate deck space on the vessel. Issues of tampering with electronic monitoring equipment have also been raised, although advances in tamper-evident gear have been made recently. Another important question raised with regard to EM is how well its data would stand

up as evidence in a court of law. Chain of custody could be hard to effectively document in some cases. Ultimately, electronic monitoring can be a valuable component of management plans, but is best suited to certain subsections of fisheries observation. In scenarios such as vessels with extremely limited space, or fishing operations that provide good access for remote video viewing, EM is a great choice, and very cost effective. In some other fisheries where the management plan is very sample intensive, EM cannot really compete with a live observer. As technology marches on, and management practices change, EM could very well play a large part in fisheries data acquisition, but for now it serves well in a complementary role to traditional fisheries observation.

## Session 3b

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### USING OBSERVER DATA AND SATELLITE MONITORING TO IMPROVE ESTIMATES OF FISHING EFFORT

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This paper aims to compare the data from observers on the INIDEP (National Institute of Fisheries Research and Development), the satellite monitoring system and fishing logbooks, in order to verify the differences or similarities observed between these three data sources, with respect to hours of trawling and hauls (fishing effort) so you can verify the performance of the fleet operating on common hake (*Merluccius hubbsi*) in a specific area of the Argentine Sea. We calculated the number of sets and total fishing hours from 19 vessels, 13 fresh fish, belonging to the substrate III (vessels have an engine power of 900 to 1399 HP and a length between 32 m to 60 m) and 6 fresh fish, belonging to the substrate IV (vessels have an engine power of 1400-2000 HP and a length between 41 m to 60 m), which made 1075 commercial fishing hauls in a selected area between 40° S - 42° S, in 2011. Analysis of these data showed that fishing effort calculated based on satellite monitoring can provide reliable and be complementary to data recorded by observers on board and from the fishing logbooks.

### AN ECOSYSTEM BASED APPROACH TO SELF-REPORTED DATA

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The Study Fleet Program, under the Northeast Cooperative Research Program, partners with a subset of commercial fishing vessels to collect high quality, high resolution, self-reported data on fishing effort, area fished, gear characteristics, catch, and biological observations. Data collected from these vessels can be used for a variety of different purposes such as supplementing the stock assessment process, developing real time hot spot avoidance maps for industry, providing detailed food web dynamics information to scientists, and contributing environmental information to habitat modelers. The Study Fleet Program utilizes a variety of technologies to aid in data collection including integrated gps units, depth sounders, and vessel monitoring systems, wireless temperature and depth loggers, wireless length frequency boards, and the self-reporting Fishery Logbook Data Recording System (FLDRS). Depending on the needs of industry and scientists, FLDRS can be tailored towards specific projects including tow-by-tow biological research, the collection of enhanced biological data, and studies pertaining to gear characteristics. With the array of data collected, and ability to provide a dynamic self-reported data system, the Study Fleet Program provides a unique ecosystem based approach to the collection, analysis, and production of industry-dependent data.



## MONITORING OF THE ARTISANAL FISHERY OF ANCHOVY FOR DIRECT HUMAN CONSUMPTION: A CHALLENGE FOR THE PERUVIAN FISHING LOG AND OBSERVER PROGRAM

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Artisanal fisheries represent an important source of economic and social development in Peru. They provide employment and income for the population, and also deliver raw material to the canning and frozen seafood industry, which helps to alleviate malnutrition in the country. Since year 2000, landings from the artisanal fishing fleet targeting anchovy for direct human consumption have presented an increasing trend due to encouragement of fish consumption by the Peruvian government. The anchovy (*Engraulis ringens*) is a pelagic fish, considered a valuable source of high quality animal protein, rich in essential amino acids, minerals, vitamins, and high in omega 3 and 6. In spite of its importance, there is still little information regarding this artisanal fishery. For this reason, since year 2008, the Peruvian Fishing Log Onboard Observer Program (IMARPE), expanded its coverage and data collection to the artisanal fishing fleet. In the present study, the artisanal small-scale fleet (10m<sup>3</sup> - 32.5m<sup>3</sup> hold capacity) was evaluated in three ports with the largest landings of anchovy for direct human consumption during the period 2010-2012. These ports were located in northern Peru; two in the Piura region: Paita and Parachique (4° - 5° S) and one in the Ancash region: Chimbote (9° S). Data collected by IMARPE observers deployed onboard the fleet were used. These data consisted of catch and fishing effort records obtained during fishing operations, as a way to get the field validation of the participation of fishermen and boats in the resource extraction. This information was used to evaluate the performance of the artisanal fishing fleet, determining effective fishing effort units (travel time, seeking time and duration of gear deployment) that adequately reflected the effect on catches. Also, catch per unit of effort values were obtained to estimate the resource abundance and its seasonal variability. Additionally, the frequency of incidental catches in the total catch of the artisanal small-scale fleet, as well as the vertical distribution of schools of anchovy in the coastal zone of the Peruvian waters was analyzed.

## EVALUATIONS OF THE ARTISANAL TUNA FISHERY: AN INDONESIAN CASE STUDY

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The artisanal tuna fishery in Indonesia is one of the most important business activities in Indonesia. Not only does it offer large-scale employment, but also provides a food supply for the community. Considering its importance, accurate data and continuously monitoring system are required for sustainability of the artisanal tuna fishery. The Research Institute for Tuna Fisheries Benoa has conducted monitoring for artisanal tuna fishery in Indonesia since October 2010 and is ongoing. The aim of this study is to determine the condition of the tuna fishery monitoring activities in Indonesia. Nine locations of artisanal tuna fisheries were sampled from October 2010 until August 2012. Once completed they were evaluated using Indicators Questionnaire for Artisanal Fisheries issued by the FAO-OSPECA Regional Workshop in 2006. From the questionnaire it was found that the majority of monitoring in Indonesia in moderate condition (78%). Others are in high and low condition with 11% each. In general, indicators of capture, effort and area are in good condition. In contrast, indicators of economy and sociology are in poor condition. These results are expected to be used as guidelines for governments and stakeholders to formulate better monitoring activities for artisanal tuna fisheries in Indonesia.

## ANNUAL CHANGE IN COASTAL FISHERIES IN THE UPPER BASIN OF THE USUMACINTA RIVER, TABASCO, MEXICO.

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In the upper basin of the Usumacinta River, artisanal fisheries represent an important economic activity for the communities located along the waterfront and coastline, where the river Usumacinta exits. These fisheries are mainly based on native and migratory species. The objective of this study was to evaluate the inter annual abundance of commercially important species. Fishing statistics were available from records for the main fishing cooperatives in the basin. Data like fishing units, records of arrivals, catch in kilograms, fishing gear and fishing methods were obtained. The resources abundance was determined using the equation  $CPUE=C$  (total catch / E (fishing effort)). The variation in abundance of these species was defined over time. A comparison of percentage of abundance and distribution through the years was also developed. According to statistics obtained from 1990 to 2010 in the fishing cooperative of San Pedro, Balancan, the species with larger catches were eleven, but only four were those with greater economic value and significant capture abundance in relation to other species. These species were, white bass *Centropomus undecimalis* (38.75%), tilapia *Oreochromis nilotica* (15.70%), tenhuayaca *Petenia splendida* (16.62%), and pinta *Parachromis managuensis* (10.50%). Using data from 2008 to 2010, provided by the fishing cooperative in Tenosique, 17 species were determined with the larger catches. Five of those species were of major economic importance and abundance; pigua *Macrobrachium Carcinus* (46.05%), white bass *Centropomus undecimalis* (13.96), grass carp *Ctenopharyngodon idella* (12.81%), white crappie *Eugerres mexicanus* (8.57%) and smooth boba *Ictalurus meridionales* (4.89%). This assemblage (species and percentages) may be different in the case of communities located near bodies of inland waters, where demand and harvest for freshwater fish can be higher compared with the demand for marine species. According to these antecedents, it is considered important to continue evaluating fisheries and its effects on different stocks for a better understanding of the consequences of overexploitation of commercial and noncommercial species, and also to establish conservation management measures.

## DEVELOPMENT OF A LOCAL TECHNICAL ASSISTANCE PROGRAM: CONTRIBUTIONS FROM THE LOBSTER FISHERY OF JUAN FERNÁNDEZ ARCHIPELAGO.

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Artisanal benthic fisheries are an important economic source for thousands of communities scattered along the coast of South America and the world. The technical information necessary for the appropriate monitoring and understanding of these systems is often limited, sporadic or even nonexistent. This condition is usually associated with a vertical fisheries management, where users expect that both, regulations and studies come from the government. Additionally, when the information on fishing resources is limited, the management tends to be dominated by the use of restrictive models (e.g. balance). In recent decades this model has been showing strong signs of exhaustion due to the inability of the fishing authorities to finance, and work at spatial and temporal scales that are relevant for the understanding of the structure and population dynamics of these resources. A different approach, emerging from the communities, has been the development of local technical assistance programs, where fishermen are actively involved in gathering information, and are coordinated in this task by one or more community trusted researchers. The use of this approach or model allows a better facing of the difficulties associated with the “tyranny of scales”, where the complexity of the population dynamics and fishing fleet at different spatial and temporal scales undermines a proper understanding of the system under traditional methods for obtaining information. A very particular case study is the Chilean research program developed around the lobster fishery in Juan Fernández archipelago during the 2006 to 2010 fishing

seasons. This is one of the oldest national fisheries with landing records. The Juan Fernández lobster fishery is managed through a dual system; with an informal community-based quota and formal government regulations (e.g. sex, size and season). Despite great efforts displayed over decades by some regional institutions to collect fisheries and biological information in the archipelago, the information collected did not have either the appropriate frequency or spatial coverage that would allow to make inferences about the population dynamics in the Juan Fernández archipelago. To solve this problem, two research programs were developed in collaboration with three groups of fishermen in the archipelago, during the 2004-2006 and 2006-2010 fishing seasons. This paper presents the design and development of the monitoring program in the archipelago. Results are presented as well as local prognostic and its potential impact to other artisanal fisheries in the country

### MONITORING SYSTEM AS A TOOL FOR FISHERIES MANAGEMENT: A SPECIFIC CASE, THE ATACAMA REGION, CHILE.

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Since 2005, the reported extraction of benthic resources by a segment of artisanal divers in the Atacama region, largely surpassed the recorded statistics regarding extractive capacity observed for other divers in the country, creating a concept that was called the “super divers”. The reason for this condition was that an unknown number of people, registered in the Artisanal Fishing Register (RPA), but not authorized to extract benthic resources, were harvesting and transferring their illegal catch to authorized divers, who put their legal catch along with the illegal catch in the market and processing plants of the Atacama Region. Between June 2011 and June 2012, the Fisheries Development Institute (IFOP) was commended to structure and to develop a monitoring system for the most relevant benthic resources in the Atacama Region: limpets (*Fissurella spp*), sea urchins (*Loxechinus albus*) and octopus (*Octopus mimus*). The monitoring system objectives were to characterize the fishery, set the actual number of extractors (legal and illegal), identify fishing areas, analyze and monitor temporal fluctuations in landings for the species under study, and generate reliable, trustworthy and timely information that subsequently would take appropriate fisheries management measures by the Undersecretary for Fisheries and Aquaculture (SUBPESCA), a public institution in charge of administrating the marine resources in Chile. The study was conducted in the format of Fisheries Research, where all the extractors (legal and illegal) as well as processing plants interested in participating had to be a pre-registered before the research was carried out. The gathering of information was based on a sampling network composed by scientific observers who were deployed at each of the participating processing plants and who also visited the region’s waterfront. Within the relevant results, was established that 22% of people who caught limpets, sea urchins and octopus in the Atacama region did it illegally. Eliminating the “super divers” in the equation, allowed the establishment of the true scale of effort and fishing pressure on these resources. Additionally the information collected was given as a background to SUBPESCA for the regularization of the illegal divers. This study was unrestrictedly supported by the artisanal fishermen, the processing industry, and by the Atacama Region authorities, suggesting that it is possible to generate the basic conditions that would reconciliation between regional economic growth and sustainable use of natural resources. Within this framework, the indicators collected through the implementation of monitoring systems can help achieve that goal.

## RESULTS OF AN OBSERVER PROGRAM CREATED TO SOLVE THE PROBLEM OF SEA TURTLE BYCATCH IN COSTA RICAN LONGLINE FISHERIES FOR LARGE PELAGICS IN THE PACIFIC OCEAN

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<sup>2</sup> WWF, Latinoamérica.

We present the results of a fisheries observers program, which was designed and developed to solve the problem of sea turtle bycatch in long line fleets that operate in the Pacific of Costa Rica, testing different gears and techniques. The original research objectives were investigated through experiments with different types of circle hooks to reduce the capture of sea turtles in the Mahi-mahi, tuna and shark fisheries, without reducing the catches of target species and, to record the types of hooking injuries encountered. Additionally, observers trained crews and showed them better techniques for handling and release incidentally caught turtles. The participation of observers onboard was conducted with the voluntary consent of the owners and captains. A total of 20 observers have been involved in the program with different education levels and experience at sea: 17 out of them have some high school education, two have biology degrees and one has college education level. At the same time, 16 have extensive experience in fishing and live in fishing ports, and four have some experience at sea. Data were collected on 91 boats (Min = 8.1m. Max. = 23.3m, average = 11.4m, st de = 3.4 m), belonging to 90 owners and manned by 99 different captains. A total of 276 fishing trips were observed, with a total of 2607 fishing sets, conducted between April 2005 and July 2012. 4789 days were observed, and the observers trained at least 364 crew members onboard on applying techniques to manipulate turtles. 95% (4551 sea days) data were accepted for analysis, 5% (238 sea days) were rejected. We conclude that observers from the fishing sector, recruited with a proper selection protocol, well-trained and well-equipped, with adequate labor conditions, and strong supervision, are adequate for working in this fishery. This observer program shows that Costa Rica can develop a permanent and official observer program in the long line fishery, with the proactive participation of the fishing industry. About 17% of the approximately 520 boats of Costa Rica longline fleets has already participated in carrying a voluntary observer onboard.

## THE ROLE OF COMMUNITY-BASED DATA COLLECTION FOR SUSTAINABLE MANAGEMENT AND CERTIFICATION OF NEARSHORE ARTISANAL FISHERIES

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Nearshore artisanal fisheries present several challenges to effective and sustainable management. Target species in this class, especially with sedentary life history traits, typically have high spatial and temporal variability, and fishery dependent indices (e.g. catch, CPUE) often do not track actual population numbers thus presenting challenges to collecting data sufficient for effective stock assessment and management. Even though many of these stocks are important fisheries resources, they often do not generate revenues sufficient to undertake costly routine surveys and monitoring programs needed for stock assessment. Community-based data collection programs improve the quality and quantity of relevant fishery information by enhancing spatial, temporal and categorical resolution as well as significantly reducing the monetary costs of data collection. We present results from a community-based data collection program that has been ongoing since 2004 for red sea urchins (*Strongylocentrotus franciscanus*) in San Diego, an important near shore resource with characteristics typical of many artisanal fisheries. This program has collected fishery dependent and fishery independent data at appropriate spatial and temporal scales, and based on its success, is being expanded to include a range of invertebrate species that are currently harvested in the absence of adequate data to assess their sustainability. Our case study illustrates the potential role of community based data collection programs for stock assessment and fisheries co-management as well as its potential to address some of

the bottlenecks for certification of artisanal fisheries. We also discuss the role of data sharing by fishermen, a key feature of our program, in building the social capital needed for cooperative harvesting strategies that optimize extraction of fishery resources.

### *MONITORING PROGRAM ABOARD FISHING VESSELS: THE IMPORTANCE OF SCIENTIFIC OBSERVERS ON BOARD FISHING BOATS*

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Some time ago the United Nations Organization for Food and Agriculture (FAO) found that an observers' program might be expensive and not suitable for all types and sizes of vessels (Kelleher, 2008). In contrast, the Fisheries Development Institute (IFOP), with its staff of scientific observers (CO) aboard smaller vessels, i.e., motor boats without cover of 6-9 m LOA, which use small lines (long lines) as fishing gear, has demonstrated for years that it is possible to establish an adequate and modest monitoring of this type of fleet. Aboard these vessels, the COs, in addition of registering the biological information (size, weight, macroscopic maturity stages and structures' removal, between others.), tried collecting information concerning fish captured by fishing gear but not retained or stored aboard the boats for landing, ergo, they immediately returned to the sea (bycatch or incidental fish).

In this paper, these statistics are partially presented and estimated with the intention to appreciate the importance or relevance these might be have specially in the indirect assessments' analysis on fisheries exploited by this type of fleet.

### *PROPOSAL TO INCORPORATE ARTISANAL FISHERIES TO SCIENTIFIC OBSERVATION ORGANIZATIONS (OPA) WITH THE AMERB REGIME IN CHILE*

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The management's areas and benthonic resources' exploitation (MABRE) presented as an alternative of generating technical information. These areas constitute an access' system to the fisheries, where coastal sectors delimited within the range of 5 nautical miles are assigned and delivered to artisanal fishmongers' organizations by an agreement on exclusive use (TURF). This system considers the development of a management's project led to the sustainable exploitation of benthonic resources, trying to fulfill goals such as: To recover, maintain and/or increase the population's biomass of the benthonic resources under an ecosystemic focus; to plan and develop actions in different fields, i.e., bio-fishing, administrative, management and to develop a fishing activity sustainable. Under this view, the fishing activity is delimited by coastal waters due to the constant presence of local fishmongers in their assigned areas. The Artisanal Fishmongers' Organizations (AFO) receive periodically training on how to monitor their areas. It is proposed to incorporate to the A.F.O., which are currently under the MABRE regimen, as Scientific Observers. One consequence of the surveillance activity in the management areas, is the constant presence of fishmongers in the areas, which generates a network of potential coastal monitors possible to be trained in the technical observation as a complement to their training in the area's evaluation. To accomplish these objectives, we propose to incorporate complementary relevant information to an Eco-systemic approach in the management plans of each MABRE, such as observations of birds, turtles, dolphins, whales and others, where the methods used to train the A.F.O. shall be proposed in relationship to the objectives of each investigation.

## INSERTION OF SCIENTIFIC OBSERVERS IN SOUTHERN AUSTRAL ARTISANAL FISHERIES

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The southern Chile craft fisheries in Magallanes region has unique characteristics in demersal fisheries and therefore scientist observers had been making gradual work to address an adequate data collection, adjusting to geographical conditions, hardness climate and socio-cultural characteristics of the small-scale coastal fisheries in Magellan Region. This is why the gathering of information has taken time and effort, systematizing the available data from many sources, often with fishermen on the edge of legality or outside of it. The observer was adapted to their terms as well he was involved in the staying places which were adapted to develop the fishing activities in order to be accepted inside their group. The observer had to acquire the fisherman's knowledge about sailing in small craft boats, to be able to make fishing operation and survival conditions in locations far from urban centers, mostly island where the shelter and operation ports are located for their activities. This is where the observer must play a key role to live among these fishermen. He must perform tasks beyond their objectives and must cooperate in every local fisheries activity. For decades craft fishermen have been reluctant to provide information to government entities or providing services to the government. Eventually Fisheries regulating laws have been implemented registering both people and ships engaged in this activity. Some fishermen, due to their culture, idiosyncrasy or simply for not meet legal requirements have been left out of fishing resolution to perform in any fishery. They are mostly those who are fishing in the places where the observer is collecting data. It is in that moment where all cooperation, support and confidence displayed by the observer takes a very important role. Nowadays scientist observers who work in the Magallanes Region have earned a place in craft fishery, because of this, it has been able to gathering valuable information "in situ" despite the complexity task involves.

## TOWARD A COMPREHENSIVE MONITORING SYSTEM FOR THE SEA URCHIN FISHERY (*Loxechinus albus*) IN SOUTHERN CHILE.

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The complexity for benthic fisheries management lies mainly in the heterogeneous spatial distribution of the benthic resources and the number of vessels engaged in the fishing effort, which in Chile is usually not known. These complexities affect the results of the information obtained directly from the fishery, becoming necessary to complement the fishing modeling with the monitoring of population indicators on a local level, in order to provide decision makers with more robust information. One of the most important benthic fisheries in Chile is the sea urchin fishery (*Loxechinus albus*). This fishery is subjected to a management plan whose objectives are directed toward the economic development, social equity, and sustainability. Under this Plan, both fishing and populations indicators have been defined, in which progress has been made since year 2005. As a result of this progress, the decision makers have appropriate tools for fishing modeling and to monitor population indicators. The objective of this paper is to present the progress made by the Comprehensive Monitoring System developed for the fishery of *Loxechinus albus*. This system has two fundamental approaches: i) it is based on the biological and fishing monitoring performed by the Fisheries Development Institute (IFOP), and its results have been applied to the resource stock modeling through use of "CatDyn" in R.1.14, ii) it seeks to implement a network of fixed monitoring stations for local populations. The variables selected for the resource monitoring are; the sizes of aggregation, sea urchin density, abundance in the transect, diameter of the head, associated communities, algal cover, and substrate type Using these variables, spatial aggregation, recruitment, and community indicators have been constructed. So far the CatDyn model has been applied for the evaluation of the sea urchin stock, and a preliminary methodology for determining a monitoring network for local population (aggregations) has been developed.

## EXTRACTIVE FISHING ACTIVITY OF THE SEA URCHIN (*Loxechinus albus*) IN THE MAGALLANES REGION, CHILE

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Official data show that the sea urchin (*Loxechinus albus*) fishery in the Magallanes Region is the largest in the country, representing 38.1% to 48.7% of the national total landed catch for this resource, during the last 8 years. According to information generated by IFOP, catches of sea urchin were made between 49° S and 55° 45' S, creating logistical problems for the monitoring of this fishery. Given the large size and geography of this region, the fishing activity is carried out mainly by two clearly distinguishable fleets; extraction fleet and transport fleet. The main catches have been recorded from 25 areas, contributing to 46% of the landings. Most of these areas have oceanic influence and are located in both, the Patagonian and Fueginians fjords and channels, which can be grouped into nine geographic subareas. Between the years 2003- 2011, Puerto Natales has concentrated 51% of regional landings, followed by Punta Arenas and Bahía Mansa with 35% and 13% of the regional landings respectively. This same resource accounted for the operation of a number of divers ranging from 294 to 569. However, these data correspond to a sample, and the existence of a significant amount of unreported/illegal catch may alter this effort indicator. The average diving depth has remained stable, ranging from 7.6 to 3.24 m and from 9.6 to 3.08 m. The size structures of landed specimens have presented mode values above the minimum legal size for extraction, however the percentage of individuals under legal minimum size has increased compared to values reported previously (Arana, 2005). All the data were collected by a monitoring system that was implemented by IFOP in 2005 and has been maintained over time. Additionally, a view of the implemented system, its achievements and constraints are provided.

## OBSERVING THE CALIFORNIA SET GILLNET FISHERY; SMALL FLEET, SMALL BOATS, LARGE AREA

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The National Marine Fisheries Service (NMFS), Southwest Region (SWR), has placed observers in the California set gillnet (SGN) fishery since 1990. During the early years of the program, the SGN fleet operated from San Diego, CA, to Monterey, CA. The SWR observer program operated field offices in four different ports in order to monitor fishing effort and deploy observers. Recently, the fishery has contracted to southern California ports and effort has decreased in response to a series of time/area closures. Now the SWR observer program operates from a single location, deploying a small corps of observers over a wide area. While not an artisanal fishery, some of the same challenges experienced in observing such fisheries are encountered in the SGN fishery. Difficulties encountered in observing this fishery now include; tracking fishing effort, calculating total fishing effort, having few observers covering several fisheries over a large area, communications with vessel owners, and ensuring the observer program monitors a representative sample of the SGN fleet. Here, we discuss lessons learned while observing a changing SGN fishery and offer advice to other programs encountering similar difficulties.

## *DEVELOPMENT AND IMPLEMENTATION OF REMOTE MONITORING AND BI-DIRECTIONAL COMMUNICATION SAMPLE FLEET FISHING VESSELS WITH ACQUISITION OF ENVIRONMENTAL VARIABLES*

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Despite the development of systems, equipment and fishing techniques on larger fishing vessels scales as well as progress in terms of technology in the current globalized world, there is still a backlog of development in the fishing industry. This development includes security issues, techniques, equipment and monitoring on fishing location. It is very important to implement monitoring devices for vessels to achieve greater security know the location for research projects and record the variation of environmental conditions surrounding the coastal environment or specific areas with some importance to science. Currently around the world, there is a great diversity of marine communication devices that are used primarily for monitoring and displaying the boat path. This technology is usually made up of two components. The first relates to the central processing unit, which is the control. The user interface is generally installed in the cockpit of the boat and accessible by the captain. The second element is the satellite module, which is set at the highest point on the vessel to prevent signal interference from other electronic devices. Because of this and in order to support the vessels used for fishing, we developed a portable maritime communication device (DCM) taking into account the characteristics needed for that sector. This device is intended to allow real-time monitoring of boats through a geographic information system and environmental data collection using a NMEA 0183 port. Among the most remarkable functions of DCM is transmitting the vessel's position in real time through the GSM network and / or satellite global coverage achieved (apart from the poles). It also has a compass tilt offset making it possible to determine hazardous conditions at sea, and identify the tipping of the boat and includes an emergency button. Moreover, the DCM allows receiving messages from a database with information that can be displayed on the screen, such as informative newsletters and weather reports. It also has the function of self-direction of the boat, which can be used to support another boat and a battery that provides up to 3 days of continuous use and can be charged directly.

## *MONITORING STRATEGY FOR ESTIMATING BENTHIC FISHERIES LANDINGS IN THE X REGION OF CHILE*

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This paper presents a methodological approach to estimate the landing of benthic resources in artisanal fisheries in the X Region of Chile. The analysis is based on data collected in the benthic fisheries capture Monitoring Program, which applies a sampling scheme in the main landing centers. Taking into consideration the characteristics of the population under study, we propose a stratification of centers, on three levels, according to the relative importance of the landings. Based on official statistics, in 2010 and 2011 there were between 67 and 77 landing sites with benthic resources. Of those 6-7 ranked in Stratum I, whose contribution exceeds 80% of such regional landing resources; 9-15 correspond to Stratum II and the remaining number of landing centers (over 70%) classified in stratum III. For each stratum we propose a sampling strategy that includes a census of centers in strata I and II, with a sampling of trips within each center, but with different sampling intensities per stratum, while, for stratum III we recommend using the official landing statistics, incorporating quality control surveys to validate data delivered by informants. In the first stage, landing estimates by species were made for the main centers, using average estimates referenced to an auxiliary variable, in this case, the trip, where their population value (total trips) must be known. For Quellón's main landing center for benthic resources, we used a ratio estimator where the auxiliary variable corresponded to clam landings whose information was obtained from an alternative source, the Health Service, which controls the landing of shellfish of this center in prevention of red tide. We analyzed the estimates of the main landing sites, noting that it has adequate sampling coverage to estimate fishing rates, but



there is deficiency in the expansion factors to estimate the total landings, since there are limitations to the known universe of fleet trips for the spatial and temporal domains of interest.

## NEW STATISTICAL METHOD TO MONITOR THE BRAZILIAN ARTISANAL FISHERIES

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<sup>2</sup> IBGE\ Coordination of Methodology and Quality, Brazil

The Brazilian Environment Institute and Renewable Natural Resources - IBAMA carried out the Brazilian fisheries' statistics through almost the entire Brazilian coast during 2008. ESTATPESCA Method was used, which had an unsolved problem, namely: The need of a dynamic vessel's register of the artisanal fisheries in the region, every day and in each port. The fishing strategies, of small fishermen, are highly variable, which makes impossible the data' updating of fishing fleet.

A new methodology was developed to avoid this problem based on a sampling divided in three faces:

- The first face is a random selection of the ports. A ports' stratification required using the knowledge of the interesting parties, i.e., specialists and local people, where the port's size, measured by the boats' number, the landings' weight and the environmental issues, are important factors.
- The second face is the disembarkation' stratification taking in consideration the corresponding port and the embarkation' size. Boat strata are defined based on local fleets' features, such as their total length.
- The thirist face is a random sampling, i.e., systematic selection of disembarkations of small and large vessels.

This methodology was carried out in two regions: Espirito Santo state from 2011 and Lagoa dos Patos in Rio Grande do Sul from 2012. The variation coefficients' results (CV) were obtained by the estimated total catch by fish species.

Note. "The IBGE disclaims any responsibility for the views, information, data and ideas expressed in this article, which is the sole responsibility of the author"

## Session 6

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### 22 YEARS ON – THE CHARACTERISTICS OF THE NAMIBIAN FISHING FLEET AND THE IMPACT ON OBSERVER SAFETY AND MORALE AT SEA

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Fisheries legislation in Namibia require that all fishing vessels operating under any right of exploitation inside Namibian waters and Namibian flagged vessels operating in any convention area to which Namibia is a party to must carry a fishery observer onboard. Since the inception of the observer programme in Namibia a number of commercial fishing vessels were involved in accidents or near accidents at sea sometimes with observers onboard. A number of factors contributed to these incidents which include human error, age and structure of vessels and sea conditions. In addition to safety concerns for observers, morale are also negatively influenced by conditions on some vessels like lack of facilities for personal hygiene and privacy considerations, especially for female observers. Should observers be deployed on all fishing vessels in order to meet statutory requirements? Issues that will be highlighted are the age structure of the Namibian fishing fleet in the different fisheries that are monitored as well as other health and safety challenges observers are faced with in the fleet.

## *GAPS IN OBSERVER SAFETY AND HEALTH IN THE HAWAII PELAGIC LONGLINE FISHERY*

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The reality of life aboard the great number of commercial fishing vessels with foreign crews can be lonely, unwelcome, cramped, and sometimes hostile. The Hawaii longline fleet is sectorized in three categories based on ownership of vessels, Vietnamese, Korean, and other. The crew compositions are Filipino, Vietnamese, Indonesian, Micronesian, Kiribati, Tongan, Fijian, and Samoan. This situation makes cross cultural communication a necessity for the observer's safety and health while at sea, because on some of the vessels the captain and crew only know a few words in English. The disparity in experience and education between observers, vessel operators, and crew can make the observer's job that much more difficult to carry out. With all the different cultures encountered in the fleet an observer needs to be an ambassador on top of all his or her other duties. Developing a strategy to incorporate cross cultural communication into observer training with practical exercises could alleviate some of the issues. Including fishing industry representatives, vessel operators, and council members to participate at observer trainings would also help with the deployment of new observers as well as increase the knowledge of seasoned observers.

## *HOW TO BUILD A STRONG SAFETY CULTURE IN THE WORK OF FISHERIES OBSERVERS*

Trujillo, H.<sup>1</sup>, Trujillo, E.<sup>2</sup>

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<sup>2</sup> Comision Interamericana del Atún Tropical.

The commitment to sustainable development acquired by institutions engaged in fisheries research begins with the collection of data on fish plants and aboard vessels by Fisheries Observers who perform high-risk jobs. They must register with institutional policies for the protection of the assets, people and the corporate environment. In this trilogy the individual is the cornerstone. It is he who designs, develops, implements and monitors compliance with the laws, rules and procedures relating to this trilogy. We maintain that the person is the basic resource for building a strong culture of safety in high-risk jobs in any socio-ecological system (SES) and that their knowledge and expertise make it an actor who experiments and validates processes through a mode of communication that is the backbone of that culture. A culture is a network coordination of actions and emotions in language that sets a particular mode of interlacing and thrilling act of people who live it. All human activity takes place in the conversation and all human activities are given as different systems of conversation. This network is built using a communication mode as part of an inquisitorial system (IS) where both articulate a closed network of conversations in which the knowledge and skills of each individual are intertwined to bring on hand and operating models indicators of quality and safety associated with different environments and conditions.

## *OBSERVER SAFETY THE AFST WAY: SAFEGUARDING ENGLISH FISHERIES OBSERVERS*

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Centre for Environment, Fisheries & Aquaculture Science (Cefas), United Kingdom.

Working as a commercial fisherman around the British Isles is recognised as one of the most dangerous occupations in the UK. Since 1990 the Marine Accident Investigation Branch (MAIB) have reported 128 separate accidents of which 38% have resulted in the loss of one or more lives. Likewise observing the fishing industry while at sea is a dangerous profession. The fisheries observers of the Applied Fisheries Science Technology group (AFST) of the Centre for Environment, Fisheries & Aquaculture Science (CEFAS) collect data from a very diverse fishing industry. AFST observers sample a number of different fishing gears on vessels ranging from 7m (23ft) in length up to 40m (131ft) or more. Data collection occurs on open decks, on shelter decks and below deck on vessels operating in anything from a few metres of water to over 1000 metres depth. A variety of weather conditions and fatigue exacerbate an already dangerous working environment. To be able to complete their duties and return home safely, AFST observers must be prepared and conversant with potential hazards within this diverse working environment. Having familiarity with standard operating procedures, undergoing an intensive training program, performing a regular review of risk assessments, recurring quality control checks, provision of safety equipment and personal protective equipment, including a primary work objective to follow health and safety policies; helps to ensure that the risk to observers is minimised wherever possible.

## *THE OBSERVER'S ESSENTIALS KIT: TOOLS FOR EXTENDED TRIPS ABOARD COMMERCIAL FISHING VESSELS*

Williams J.D.

NOAA, USA.

Observers are a unique breed; they thrive in marine environments despite multiple hazards. They must contend with a wide range of vessel conditions that are beyond their control while collecting and processing data. Completing a three-day trip involves an entirely different mindset than the one required to capably carry out 50 or more days aboard. A combination of personal responsibility and organizational support forms the basis for accomplishment. This presentation draws on recommendations from agencies and organizations, as well as first-hand observer experience, to create an 'Observer's Essentials Kit' that can mean the difference between success and failure on board. An Observer's Essentials Kit should include items that can be utilized for maintaining both physical and mental health. On the physical side, an observer must anticipate guarding personal health in challenging environments. This includes basics like gear for foul weather - extreme heat as well as cooler temperatures - but also personal items that make life easier aboard a vessel. An observer should plan for a night on deck trying to sleep in 100 degree weather surrounded by mosquitoes, or a trip challenged with organizing lab equipment in tight quarters shared with unfriendly crew. Proper observer gear can make life much easier and increase the likelihood of a successful trip. Observers will be faced with barriers of language and culture, diverse personalities and vast differences in life experience. Tips for effective personal communication will be presented. The sacrifice observers make to their health, welfare and family time can be eased with the right gear and mindset. The personal health and safety of the observer must be a priority so that hardships may be endured without compromising the integrity of the observer program. An Observers Essentials Kit could easily be standardized and incorporated into observer training programs, thereby partnering personal responsibility of the observer with that of organizational support personal health and safety, and reduce risk. Observers can be trained to predict and plan for their own potential medical needs 30 days out before setting foot on board: an essential gear and medical kit checklist will be provided and discussed. Mental health can be preserved with the right gear as well. Taking personal items that maintain ties with family and friends are important, as are tools for distraction: a laptop loaded with movies and audio books can mean the difference between sanity and the dreaded alternative.

## *THE OBSERVER SAFETY INCIDENT REPORTING SYSTEM: A TOOL TO LEARN FROM, AND REDUCE OBSERVER SAFETY INCIDENTS*

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Global Marine Monitoring, USA.

The Observer Safety Incident Reporting System (OSIRS) is global initiative that records and examines all types of Fisheries and Marine Observer safety incidents on board fishing, seismic and dredge vessels, drilling operations, pile driving, marine blasting and fish farming, including port and shoreside facilities. The OSIRS collects voluntarily submitted Fisheries and Marine Observer safety incident/situation reports from observers, observer providers, fisheries agencies, debriefers and others stakeholders; analyzes them, and responds in order to lessen the likelihood of Fisheries and Marine Observer safety incidents. All personal and organizational names are removed, dates, times, and related information, which could be used to infer an identity, are either generalized or eliminated, the OSIRS acts on the information these reports contain, it identifies system deficiencies, trends on observer safety and issues, alerting messages to persons in a position to correct them, it educates through its reports, and through its research studies. The database is a public repository which serves the observer stakeholders needs and those of other organizations worldwide which are engaged in research and the promotion of safe at sea observation. The Project has an electronic reporting form which automatically uploads the incident data into a database available for further analysis. OSIRS will maintain a computerized database of reportable observer accidents which have occurred since the start of the program besides providing an accessible source of information, the database can be analyzed to identify accident trends. OSIRS data will be used to identify deficiencies and discrepancies in the Observer Safety Protocols so that these can be remedied by appropriate authorities and to support policy formulation and planning. Yearly reports, and a collection of short, anonymous reports on the lessons learned from examinations and investigations will be available for the stakeholders. These publications hope to provide details of the outcomes of recommendations based on its findings, it endeavors to identify and analyse the relevant safety issues pertaining to the specific accident, and to make recommendations aimed at preventing similar accidents in the future.

## *WORKING SAFELY IN THE SOUTHEAST AND GULF OF MEXICO FISHERIES*

Hutton, S.R.

NOAA (fisheries observer), USA.

Commercial fishing is the deadliest occupation in the United States. Fisheries observers are exposed to many of the same hazards as fishermen while on board the vessels with the added risks of harassment and violence. The Southeast and Gulf of Mexico have especially worrisome records of injuries and deaths and continue to lag behind areas like Alaska in safety regulations. Observers in the Southeast may not experience frigid waters but extreme tropical weather, infections like MRSA, and a lax safety culture among the fishermen require constant attention to safety. Extensive safety training incorporating hands-on practice is essential in preparing observers to avoid and survive minor injuries to life threatening situations. Receiving, maintaining, and knowing how to use safety gear is equally important. A pre-departure vessel safety check should be treated seriously and be used as an opportunity to gauge and improve the safety competency of the captain and crew. The fishermen may or may not be prepared for an emergency situation, so observers must be ready to take care of themselves and others if one arises.

## *WORKING SAFELY IN THE SOUTHEAST AND GULF OF MEXICO FISHERIES*

Kuda, D.

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Through personal experience during the past 5 years, I have been working on ways to stay fit while at sea on extended trips when observing on small (31-89') commercial fishing boats in the Gulf of Mexico. With some exercise ideas from a personal trainer and creative problem solving, I was able to improve my cardiovascular fitness on long trips (18-58 seadays). I found that doing circuit or sustained exercise routines involving a combination of exercises like jump rope, steps, lunges, calisthenics (e.g., pushups, pull-ups), and elastic bands strength exercises (e.g., rows, flies) to be successful in working off excess body fat in order to maintain a healthy weight. While trying to find ways to stay physically fit, I discovered more ways to stay mentally fit as well. Like many observers, I have usually brought books to read on trips. Three years ago, I started bringing and playing my ukulele on trips and found it very helpful in promoting an enjoyable trip for myself and the crew. Other ways that I found helpful to mentally unwind was writing haiku (3 line poetry), composing seascape photos, and making gyotaku (fish printing). In my observer experiences, I have found doing things that make yourself happy and hopefully others promote good attitudes and calmer minds. There are many things to consider with each boat and crew assignment. Considerations for exercising: a dry space to workout, adapting to the boat schedule, workout equipment available or adaptable, and shower availability after a workout. Considerations for mental health including, current hobbies (e.g., puzzles, drawing), amount of space onboard to accommodate hobby equipment, start a new hobby that doesn't require a lot of space (e.g., harmonica, meditation, learn a language). I have found ways to successfully maintain and improve observer health while offshore for extended trips using creative thinking. I think that other observers may use my findings as a guide to customize their own program for staying fit.

## *THE THREE P'S OF RISK REDUCTION*

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Observers encounter many hazards working on both commercial and recreational fishing boats. It is of utmost importance to mitigate these risks so that the observer can function as expected while on board a vessel. I propose that risk can be reduced by incorporating three fundamental elements into your observer routine. These elements are preparation, prevention, and practice. In order to reduce risk the observer should prepare in multiple ways, as well as perform preventative processes, and finally practice emergency procedures so that while on board a vessel they will be safe. The three P's will be further broken down into their respective specifics and displayed in poster format for the conference.

## Session 7

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## *SCIENTIFIC OBSERVER PROGRAM FOR JACK MACKEREL FISHERY IN INTERNATIONAL WATERS OF THE SOUTH PACIFIC OCEAN*

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The Fisheries Research Institute (INPESCA), is a private institution dedicated to applied scientific research to provide timely and high quality scientific advice to the fishing industry of central-southern Chile. During the period 2008-2010, INPESCA implemented a pioneering program to validate fishing areas for mackerel and its connection with

environmental characteristics in meso scale and local scale. This Program, driven by changes in the distribution of mackerel fisheries due to displacement of fishing activities into international waters off south-central Chile, consisted in the refitting of a trawler fishing vessel into a bio oceanographic vessel for searching of fishing areas and scientific research. The main objective of this Program was to increase efficiency and to reduce the searching times for mackerel fishing grounds for the regional fleet, in large open water areas of the Southeast Pacific Ocean. In this program, which included a group of qualified scientific observers, data was gathered in areas such as physical oceanography, plankton, hydro-acoustics and fisheries biology, biophysical information, biological and fishery information, as well as resource and acoustic recordings was gathered. Additionally this information was combined with real time satellite information (mainly sea surface temperature, chlorophyll and geostrophic currents), in order to identify regions with a high probability of containing commercial mackerel shoals, and to communicate directly with the fishing operations of the regional industrial fleet. The Program performed 22 cruises lasting 20-24 days. The project was successful in terms of increasing efficiency in fishing operations, by reducing the search times on commercial fishing grounds, improving the quality of fishing, and ultimately increasing the percentage of production destined for human consumption. In the study period (2009-2010), fishing grounds recommended for mackerel, accounted for 25-40% of the total annual catch. On the other hand, this program also analyzed local and mesoscale relationships between the resource distribution, its behavior, and variations in the biophysical components recorded in the fishing regions. This information has improved the knowledge of migratory behavior of the resource, and intra seasonal dynamics of the resource instantaneous acoustic biomass, allowing the assessment of short and medium term forecasts for the state of the resource. The approach used in this program allowed a close and effective guidance for the regional fishing industry targeting mackerel, and also provided relevant guidance to the state administration associated with the incorporation of new information on the distribution, behavior of the resource, and its association with biophysical changes in international waters off south-central Chile.

## *SUMMARY OF THE NORTHEAST FISHERIES OBSERVER PROGRAM'S SPECIES VERIFICATION PROGRAM*

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NOAA's National Marine Fisheries Service is responsible for the management, conservation, and protection of living marine resources within the United States Exclusive Economic Zone. The Northeast Fisheries Science Center (NEFSC) conducts ecosystem based research and assessments of these resources. The Northeast Fisheries Observer Program (NEFOP) and the At-Sea Monitoring Program (ASM), part of the NEFSC's Fisheries Sampling Branch (FSB), collect, process, and manage data and biological samples obtained during commercial fishing trips from Maine to North Carolina, USA. These programs strive to provide accurate and precise near real-time data for fisheries management. In 2009, digital cameras were issued to all NEFOP observers, requiring them to submit photographs of all species of concern and encountered finfish for verification. These photographs are evaluated by FSB staff and prompt feedback is provided to observers concerning correct and incorrect identifications, minimizing future errors. We reviewed the records for photographs submitted to this species verification system, looking at both NEFOP and ASM data, to assess whether successful (based on 85% program standard) identification of certain species was influenced by observer experience. Based on an informal, qualitative verbal survey of experienced observers, we determined observers to be experienced after four months, and arbitrarily chose one year as the criteria for veteran status, evaluating percent correct submissions within these periods. Overall, pinnipeds, cetaceans, sea bird and herring identification did not improve with experience but maintained a success standard of 85%. Shark and sturgeon identification improved with experience though the standard of success was not met until the 'experienced' and 'veteran' statuses applied respectively. These results can likely be summed up to lack of exposure. This study provides results that can be directly applied to improving training methods for field identification and provides an objective summary of observer's identification abilities. Species verification programs should be routinely evaluated to identify and address weaknesses, and to characterize the accuracy of data collected by observer and at-sea monitoring programs.

## SEABIRD BYCATCH IN ALASKA TRAWL FISHERIES: A COMPARISON OF OBSERVER SAMPLING PROTOCOLS

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Seabird bycatch in commercial fisheries, especially longline, trawl and gillnet fisheries, is recognized as a global conservation problem. In some southern hemisphere fisheries the bycatch of certain albatross species has been identified as the cause for serious population declines. North Pacific Groundfish Observers conduct species composition sampling on trawlers to support estimation of total removals for a variety of species. Sampling protocols work well in support of estimates of mortality for most fish species. Unfortunately, the estimates of seabird mortalities associated with trawl fishing operations is likely biased as seabird mortalities may also occur from encounters with rigging (trawl sonar and trawl door cables) or the net forward of the codend. Current sampling protocols are not able to account for either of these situations. Observers have been collecting data on seabird interactions with trawl warps, nets, and third wires over several years as part of a special project assigned to prior, experienced observers only. We compare seabird bycatch based on current observer protocols with the number of birds caught using the specialized observation protocols. Initial summaries reinforce the hypothesis that current estimates are low. We review changes incorporated into standard operating procedures for observers as a result of this work and recommend methods to improve seabird monitoring on trawlers in Alaska.

## SAMPLE SIZES FOR ESTIMATING THE LENGTH COMPOSITION OF THE CATCH UNDER A TWO-STAGE SAMPLING DESIGN

Young, Z., Saavedra, J.C.

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A simulation study is used in the determination of sample sizes to estimate the length-frequency distribution of the commercial catch in pelagic fisheries in the central southern Chile. We analyzed data for sampling length of four species, anchovy (*Engraulis ringens*), sardine (*Strangomera bentincki*), sardine austral (*Sprattus fueguensis*) and jack mackerel (*Trachurus murphyi*), which were collected in the monitoring program of pelagic fisheries using a sampling design stratified by port and month. To estimate the length composition we used an estimator based on two-stage sampling. In this design the first stage sample units are fishing trips and the second stage sample units are fish. The size frequency distributions estimated from the total length data by species and stratum were assumed as the structures "population". Simulation techniques were used to examine the effect of the different sample sizes. For each sampling scenario length distribution was estimated and compared with the similarity with the length distribution "population" using an error index. The results indicate that for sample sizes over 50 fish per trip, the gain in precision is marginal, confirming that the general shape of a length distribution can be captured with small samples of specimens measured by trip. Mean length was estimated with high precision with samples as small as five fish measured per trip. At the first stage units (trip), the simulation results suggested different sample sizes for the same level of precision, depending on the degree of variability of size structures for the respective species and strata. The index decreased rapidly with increasing sample size and for trips over 15, the addition of a new unit contributed less than 4% improvement in the error rate of lengths structures. For more than 30 trips, the error curves have an asymptotic trend. As described in previous studies, the precision of the estimate was much more sensitive to variations in the number of trips sampled than variations in the number of fish measured into the trip, creating a sampling strategy oriented to sample a few fish on the trip and favor more trips observed.

### CHALLENGES (CONDITIONS) OF DATA COLLECTION FOR SCIENTIFIC OBSERVERS IN DEMERSAL CRUSTACEAN FISHERY OPERATING IN CENTRAL CHILE.

Yáñez, O., Galleguillos, R.  
Instituto de Fomento Pesquero, Chile.

The crustacean trawl fisheries from the Chilean fleet are a great challenge for data gathering from the selection of the boat catch sampling. As in any process there are several factors that influence the final product, in this case the data. For example, the effect of meteorological conditions on the instruments and the observer, and also the effect of the observer on the behavior of the rest of the crew, and the discard.

### TRUST: FUNDAMENTAL BUILDING BLOCK TO ENFORCE LAW 20.625

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From 1964 to 1969 the Instituto de Fomento Pesquero (IFOP) carried out a series of 15 demersal exploratory fishing cruises along the Chilean coast from Taltal to Diego de Almagro Island. Forty two species were caught in the standard shrimp trawl sampling unit. For 16 of these species the catch amounted to 50 kg or more per hour of trawling. Based on these findings in 1972 IFOP pointed out that: 1) a large scale trawl fishery based upon *Merluccius gayi* (merluza común) and *Macruronus magellanicus* (merluza de cola or hoki) might be extended from Talcahuano to Valdivia as a first step, 2) as a second phase operations could be extended to Guafo Island and, 3) the magnitude of these resources, the distance from markets and other economic, social and political constraints will affect the final utilization of these resources. Later on IFOP's findings stimulated industrial and artisanal fishery development based upon merluza común and merluza de cola resources. Since the early origins of the hake and hoki fishery, the type of technology used, the fisheries management strategies and noxious fisheries practices bring forth a way of being within the Fishery system. This social ecological system evolved throughout many years as a web of behavioral interactions to give rise to a culture of discard of these resources. Nowadays *Merluccius gayi* and *Macruronus magellanicus* are over exploited. Recently on Monday, September 24, 2012 the Chilean Government and the Ministry of Economics, Development and Tourism and Under Secretariat for Fisheries and Aquaculture published Ley Número 20.625 "Define el descarte de especies hidrobiológicas y establece medidas de control y sanciones para quienes incurran en esta práctica en las faenas de pesca." According with Law Number 20.625 an 18 months research programme will be undertaken. To the layman, this means gathering technical information to formulate a plan to reduce discard. However fishery discards and the culture of discards are two different things that in real life constitute a wicked problem that is very difficult to solve using traditional Cartesian approaches. To deal with this dichotomy, it is advisable to come up with an unorthodox research programme. I claim that fishery discards and the culture of discards can be best managed by using a deductive-inductive inference supporting top-down/bottom-up analysis combined with abduction or inference to the best explanation. Total Quality Management (TQM) to tackle fishery discards at sea. Emotional Intelligence (EM) to deal with human behavior that is the cultural side of discards. The purpose of this paper is to explain how to evolve from the actual state of common hake/hoki discard to a non-discard culture whatever difficulties one may encounter in building trust in different domains: law enforcement professionals, industry/artisanal stakeholders, ship owners and skippers, crew members, fisheries observers, scientist and decision makers. TQM + EM+ Abduction are mortar components to build the take-off platform for Law 20.625.



## FISHERY-INDEPENDENT LONG-TERM EGG AND LARVAL SURVEYS OFF THE PACIFIC COAST OF JAPAN: SURVEY, DATABASE, MANAGEMENT, AND APPLICATION

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Fisheries observation and monitoring strategies could be complemented by fishery independent monitoring programs. For such an example, we introduce a project of long-term monthly egg and larval surveys off the Pacific coast of Japan. Extensive monthly egg and larval surveys have been conducted by 2 national research institutes of Fisheries Research Agency and 18 prefectural fisheries research institutes off the Pacific coast of Japan since 1978. The survey area covers the major spawning grounds of small pelagic fish such as sardine, anchovy, and mackerel off the Pacific coast. In the surveys, plankton nets with mouth ring diameters of 45 or 60 cm and mesh sizes of 0.33 or 0.335 mm are towed vertically from 150 m depth to collect fish eggs and larvae as well as zooplankton. Oceanographic observations such as sea temperature and salinity measurements are made simultaneously. The eggs and larvae are sorted and identified within a few months after the surveys. Then, the egg and larval data and oceanographic information are aggregated and managed in the Fishery Resource Conservation (FRESCO) system. The egg and larval database (ELDB) system, which is connected to the FRESCO, provides the working members with the outputs of the monthly densities and abundances of eggs and larvae with different spatial scales. These outputs immediately contribute to the stock assessments of small pelagic fish through egg production method and serve as the information to tune the results of virtual population analysis (fishery-based stock assessment). Currently, the long-term data set comprises a total of ca. 120,000 samples. A total of ca. 3,000–4,000 samples are added annually. In this presentation, we briefly summarize the history and system of the surveys, databases, and managements as above. Then, we also introduce our recent activities and future directions of management and application. (1) The formalin-preserved samples of eggs, larvae, and zooplankton are aggregated and archived along with the information list for a uniform management to avoid dispersion and accidental loss. (2) The preserved zooplankton samples are counted and measured by a Bench-top Video Plankton Recorder (B-VPR) to obtain further plankton data. (3) The paper documents of the historical survey results before 1978 are digitized to extend the data set period. (4) The ELDB system is improved and extended to be more coupled to relevant stock assessment works. (5) The data of eggs, larvae, and zooplankton are used in a series of biological studies on small pelagic fish and zooplankton. We anticipate a combination of long-term fishery-dependent and independent surveys to provide information essential to progresses in both industrial and scientific studies. Note: The surveys and managements introduced were conducted in the stock assessment project commissioned by Fisheries Agency of Japan, but the presentation contents do not necessarily reflect the views of Fisheries Agency.

## GIANT SQUID FISHERY OR SQUID (*Dosidicus gigas*) MONITORING PROGRAM IN PERÚ

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In Peru the extraction activity of the giant squid or squid (*Dosidicus gigas*) is performed on an industrial scale (squid fleet with international flag) and artisanal (national flag fleet). The industrial squid fishery began in April 1991, while the artisanal fishery became important after 1998. To monitor both fisheries the Marine Institute of Peru (IMARPE), has developed a Monitoring Program (PM) for the giant squid fishery (PM-pota), which collects biological, fishing and oceanographic information for this resource in Peruvian and adjacent waters. The regulations of the giant squid

fishery began with the Regulations for the operation of squid fishing boats (DS N° 005-91-PE), and after several legal procedures was reached the Fisheries Management Regulations for giant squid or Pota - *Dosidicus gigas* - (DS N° 014-2011-PRODUCE), by which bio-fishing, oceanographic and satellite tracking from the fishing fleet information has been collected, as the basis for regulatory measures and fisheries management. The main objective of the Regulation is the rational and sustainable exploitation of the giant squid, considering its biological and population dynamics, and the optimization of the economic benefits, related to the precautionary principle and ecosystem-based management. The Scientific Technical Research (TCI-IMARPE), is to obtain bio-fishing and oceanographic information from the squid fishing operations. The Article 69 of the Fisheries Law, (D.S. N° 012-2001-PE) and the Article 10° from the D.S. N° 014-2011-PRODUCE has the obligation to carry an observer from IMARPE. IMARPE has the Information Collection System from Artisanal Fisheries (Field Observers), from catch and effort on 22 landing sites, mainly covering the ports of Paita, Talara and Matarani, which together represent more than 92% of squid coastal landings. The Deputy Minister of Fisheries manages the satellite tracking system (SISESAT), with terminals located in IMARPE and Captaincy and Coast Guard Directorate (DICAPI). The SISESAT system contributes to the follow-up, control and monitoring of the fishing activities. Another element of the PM-pota, is the information from the national and international giant squid research surveys. The giant squid captures has had two periods of high abundance, the first from 1991 to 1995, with a maximum of 210,000 tons in 1994, the second from 1999 to 2011, with a maximum catch of 559,000 tons in 2008. The first period the largest catches were made by the industrial squid fleet and in the second period by the artisanal fleet.

## IMPLEMENTATION OF REMOTE SENSING TO REDUCE INCIDENTAL TAKES

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To mitigate incidental takes of endangered or protected species, a greater effort should be placed on utilizing remotely sensed data in conjunction with data collected by fisheries observers. The end result would be an experimental product that could be distributed to the fishing industry in real time to aide them in preventing bycatch. This experimental product would delineate an environmental area where fishermen would have a higher probability of catching an incidental take than normal. A similar attempt at combining satellite data with existing bycatch information was conducted in 2006- 2007 in the Hawaii-based pelagic longline industry to prevent the bycatch of loggerhead sea turtles. Nicknamed “TurtleWatch”; and distributed by NOAA Fisheries to captains, the product proved successful at predicting incidental takes. In this poster, I discuss potential fisheries where similar programs could be implemented that could help fishermen avoid unnecessary fishery closures.

## AN ECOSYSTEM AND RISK-BASED APPROACH FOR ASSESSING AND IDENTIFYING LEVELS OF FISHERIES MONITORING PROGRAMS ON CANADA'S PACIFIC COAST

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Faced with a myriad of ecosystem and economic challenges, including climate change, declining fish stocks, reduced economic viability, an evolving global marketplace, and heightened competition for aquatic resources, Canada's Pacific fisheries are undergoing reform. The growing national and international concern around ecosystem impacts of fishing and in line with government programs on fisheries reform, a critical spotlight is on the state of fisheries monitoring programs and the need for targeted and cost effective improvements. Accurate and precise, timely and accessible fisheries information is the foundation of ecosystem-based and stakeholder-supported management. Fisheries and Oceans Canada, Pacific Region (DFO Pacific) has taken steps to move toward ecosystem-based management approaches by releasing a Strategic Framework for Fishery Monitoring and Catch Reporting in the Pacific Fisheries (April 2012). The purpose of the framework is to provide a common understanding and approach to setting fisheries monitoring and catch reporting standards. To enable consistency, three levels of monitoring have

been established, Low, Generic and Enhanced, based on criteria that considers key biological and ecosystem impacts and resource management requirements. Monitoring requirements for the level of information required on catch, effort and ecosystem impacts, as well as statistical quality of catch information and need for independent verification programs are outlined. In general the principles and strategies within the framework and accompanying monitoring levels focus on the need for verification of catch in all fisheries including, retained target fish stock(s), releases, and bycatch and discards, as well as collecting information on further components of the ecosystem such as habitat impacts. A risk assessment tool, to systematically assess the level of monitoring required within a fishery is included in the framework. The assessment applies to all commercial, recreational and Aboriginal fishing activities on Canada's Pacific coast and interior waters managed by DFO Pacific. This approach examines the risk a fishing activity presents in three categories of ecosystem component(s) i.e., direct species, community and habitat impacts (benthic and pelagic), and also considers the requirements of the accompanying management regime. The analysis can be conducted using qualitative and quantitative information. A number of data sources can be used including existing fishery data such as catch and effort reports, local and traditional knowledge and information from other programs and harvesters including marine mammal response network, surveys etc. A process for scoring the ecological effects of fishing is outlined. The final score, an estimated level of ecosystem risk resulting from fishing activity, then equates to the level of monitoring required. Overall the risk assessment offers a consistent and transparent process for managers to determine appropriate monitoring levels in collaboration with harvesters based on ecosystem risk. By using a consistent approach, to assessing and determining monitoring levels and working in collaboration with harvesters in a transparent way, DFO Pacific is providing a key focus to moving ahead with ecosystem based approaches to fisheries management. This approach, which recognizes the variability of information needs across the fisheries, provides transparency and rigour in the way monitoring programs are developed and implemented which has not been present in the past.

#### *CATCH AMOUNTS AND DISCARD MORTALITY FOR NON-TARGET SPECIES CAUGHT IN COMMERCIAL FISHERIES ESTIMATED UNDER MULTIPLE SOURCES OF UNCERTAINTY USING FISHERY OBSERVER DATA*

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Maintaining fishing mortality within sustainable bounds for the numerous species that are incidentally captured in commercial fisheries is an important component of an ecological approach to fisheries. Fishery observer surveys are often the main or only source of information on the catches of these species, which are often discarded. They are also an ideal platform for collecting critical data for estimating fishery scale discard mortality rates and identifying opportunities to improve survival of discards. However a number of characteristics of these surveys pose challenges for the reliable estimation of discard amounts and mortality, and their associated uncertainty, including deployment and observer effects, and inconsistencies between observers in describing catch characteristics such as species composition. Using skates (Rajidae) caught in Gulf of St. Lawrence (Canada) fisheries as an example, show that such challenges can either be overcome using proper modelling or their consequences can at least be evaluated. Though skates are largely discarded in these fisheries and are generally not identified or incorrectly identified to species by observers, separate discard amounts and mortalities for three species are estimated. Furthermore, independent validations were undertaken to assess the reliability of certain parts of the estimation process. The result is estimates of fishing losses that can be evaluated in the context of unusually elevated adult mortality for the three species.

## *BIODIVERSITY IN THE COMPANION FAUNA OF AN ARGENTINEAN INDUSTRIAL FISHERY AND ITS RELATIONSHIPS WITH THE TRAWLING DEPTH, LATITUDE AND LONGITUDE*

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The Shannon-Weaver index has been widely used to measure the biodiversity on given samples. Application of biomasses instead of numbers of individuals for the index calculation may be considered an advantage because it does not consider the variability of age and size amongst sample individuals. Trawling samples were used to determine the biodiversity of impact of the Argentinean hoki fishery on grid cells of 1 degree latitude - 1 degree longitude for years 2007 to 2009. Although a complex spectrum of variables may affect the biodiversity of impact, we found that this index of biodiversity shows a certain degree of correlation with the average trawling depth. This occurs in some latitudes for the Austral and Surimi freezing fleets, which mainly target hoki and Southern blue whiting. This relationship was clearly observed when averaging indexes of biodiversity and trawling depth per latitude. The hake freezing fleet uses bottom trawling when targeting hoki by reducing the horizontal aperture and increasing the vertical aperture, but does not change the aperture configuration when targeting hake. This operating measure might suggest a mixing of information in samples which could explain the poorer relationship observed between the index of biodiversity and depth for this fleet. Additionally, a different relationship between the number of species occurring in each sample and the trawling depth was observed for the Austral and Surimi fleets, showing that the scope of the impact is not necessarily a measure of the degree of the impact; this last better represented by the Shannon index of biodiversity.

## *FISHERIES RESEARCH INSTITUTE SCIENTIFIC OBSERVER PROGRAM FOR THE FISHERY OF THE RESOURCE JACK MACKEREL (TRACHURUS MURPHY. NICHOLS 1920)*

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The jack mackerel (*Trachurus murphy*, Nichols 1920), is a pelagic species that straddles the South Pacific from the coast of Tasmania and New Zealand, associated with higher biomass in ocean waters, to the south-central region of Chile. Its fishery is an important economic activity that takes place primarily through industrial activity, with landings that are mainly concentrated in the south-central region of the country. Beginning in 1994, the Fisheries Research Institute, a private scientific research institution that provides timely and high quality scientific advice to the fishing industry, implemented a Scientific Observer Program on board the industrial purse seine fleet targeting jack mackerel, with the purpose of gathering permanent operational, biological and fisheries information, to improve both basic research and its spatial and temporal fluctuations, as well as the annual indirect assessment of the resource. In this Program, which has a group of highly qualified professionals, information regarding the operational performance of the purse seine fleet, the spatiotemporal distribution of the catches, bycatch analysis, as well as biological data (length frequency, sex, sexual maturity, contents gastric otoliths) are obtained weekly. This information feeds databases that are used in the analysis of population structure, growth, reproduction, and feeding behavior of the resource as well as in the annual evaluation of the resource through indirect models. An important phase of this program is the dissemination of results to the users of the fisheries, which are verified through outreach meetings, scientific meetings with managers of the fishery, and by generating monthly semiannual and annual technical reports that transfer information to users of the fisheries (fishermen). The Scientific Observer Program for mackerel, has a close association with the Fisheries Synoptic Program, which monitors the operation of the mackerel industrial purse seine fleet, and analyze environmental conditions of the fishing region through satellite information. The results of these two programs provide guidelines and recommendations to the fishing industry to optimize the

determination of fishing areas and to improve performance indicators as well as to improve the use of fisheries under the concepts of conservation and sustainability. In parallel, and in the scenario of strong regulations established for jack mackerel in recent years, the Scientific Observer Program has included in its drive technology, advice on issues related to the quality of the raw material, and to make recommendations for a stratified operation of the catches, which aims to optimize human and technical resources, strengthening the traceability, and generating information for an eventual certification of the fishery.

## *FISHERY MONITORING IMPROVEMENTS SUPPORTED BY AN INTEGRATED APPROACH TO ECOSYSTEM-BASED MANAGEMENT*

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Ecosystem based management must reflect the complexity, multi-layered and interconnectedness of ecosystems themselves. Just as ecosystems cannot be effectively conserved or sustainably utilized without considering a critical mix of factors, neither can fishery monitoring programs effectively contribute to ecosystem based management without considering a broader and comprehensive risk management approach to fisheries management. Fisheries and Oceans Canada Pacific Region (DFO Pacific) has recognized that a suite of fundamental issues must be addressed concurrently in order to more effectively address ecosystem risks and to achieve sustainable resource benefits. A comprehensive approach has been implemented to ensure that fisheries information of all kinds is accessible to both management agencies and to harvesters and must be readily integrateable in order to meet management requirements for conservation, sustainable use and compliance. In addition, monitoring programs must be sufficiently robust in order to provide the required information and to meet consistent standards for fisheries with similar ecosystem risks. Lastly, regardless of the management regime, (e.g., transferable quotas vs. derby style) accountabilities must be clear, where roles and responsibilities are understood by managers and stakeholders/harvesters. Since 2006 DFO Pacific has implemented a multi-faceted approach to modernize fisheries and support more fully integrated ecosystem management, through several inter-dependent initiatives. Development of an overarching plan was key: called "A Strategic Framework for Fisheries Monitoring and Catch Reporting (FM&CR - 2012)" which provides policy and strategic guidance (including roles and responsibilities), and a risk assessment tool to consistently determine ecosystem risk level and the commensurate monitoring requirements, ii) a supporting framework for effectively managing fisheries information, including development and implementation of a systems architecture with data standards and data management accountabilities, guided fundamental modernization of fisheries information management, iii) a program to foster development and application of new technologies and methodologies for monitoring tools such as electronic logs is instrumental to affording the required improvements, iv) adaptable management regimes to implement wide range of pilot and demonstration fisheries highlighted alternatives to achieve acceptable levels of ecosystem risk with sustainable resource benefits. Lastly, v) improved compliance with fishery controls has been facilitated through a combination of enhanced collaboration between managers, harvesters and enforcement staff on priorities, measuring of compliance rates and anticipated responses (to individual harvesters and fleets) to poor compliance, Appreciating the diverse and complex nature of ecosystems fosters a multi-faceted and integrated approach to managing ecosystem risk and achieving sustainable resource benefits. Assessing ecosystem risks and implementing the appropriate level of fisheries monitoring is but one interdependent component required for effective ecosystem-based management.

## SUMMARY OF INCIDENTAL CATCH OF ATLANTIC SWORDFISH (*Xiphias gladius*) IN SQUID BOTTOM TRAWL TRIPS SAMPLED IN WATERS OFF THE EAST COAST OF THE UNITED STATES BY THE NORTHEAST FISHERIES OBSERVER PROGRAM

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Atlantic swordfish (*Xiphias gladius*) is a highly migratory species (HMS) affected by direct and indirect fisheries. Bottom otter trawl squid fisheries in the western north Atlantic indirectly affect swordfish because the distribution of effort overlaps the distribution of the northern swordfish stock, and incidental catch of swordfish have been observed. The Northeast Fisheries Observer Program collects data on swordfish that have been caught on bottom otter trawl squid trips. Observer program data were used to determine if juvenile swordfish were caught, what percent of takes were discarded dead, why swordfish were discarded, and where in time and space swordfish catch occurred. We found that most swordfish caught on both *Illex* and longfin squid trips were dead, half were discarded, and most individuals were immature. Most swordfish were discarded because of size and permit regulations. Swordfish were caught along the 100 fathom line within the range of the *Illex* and longfin squid fishery's distribution and during the *Illex* and longfin squid fishery's offshore seasons. Future studies should determine if observer data are representative of the entire *Illex* and longfin squid fisheries. New data on sex, length, and weight of swordfish catch would greatly contribute to our understanding of how swordfish stocks are affected by fishing mortality.

## ANALYSIS OF ARTISANAL FISHERIES FOR *CENTROPOMUS UNDECIMALIS*, IN TABASCO, MEXICO

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The white bass (*Centropomus undecimalis*) is a very important resource for artisanal and sport fisheries in Tabasco, Mexico. However, the catch per unit of effort (CPUE) has declined over 50% in the last decade. The possible causes for its decrease are the overexploitation and changes in local climatic and hydrological conditions. The objective of this research was to demonstrate a possible relationship between CPUE and fishermen behavior (effort) with rainfall (PP) and sea surface temperature (SST). Data on white bass catches (kg per boat) were obtained for the period September 1999 to December 2010 in the port of San Pedro, Centla, Tabasco. Rainfall data were obtained from the National Water Commission and data on sea surface temperature were obtained from satellite images provided by the International Research Institute for Climate Prediction. The monthly average data were standardized and were tested using simple and multiple correlations. The results showed that in the first half of the period reviewed (May 2000-March 2002) the Effort and CPUE peaks preceded the highest values of PP and SST (June to August each year). While in 2002 the highest values of effort (fishermen behavior) was observed between October and December (152 boats / month), circumstance that may be related to the annually changes in weather conditions. Throughout year 2002, anomalous peaks of PP were registered. In June (250 mm), in September (425 mm), and (300 mm) in November. This change in rainfall patterns coincides the 2002 "El Niño" event. After, the Effort and CPUE repeats the behavior described above, although CPUE was low (average of 13.7 kg / boat). It is concluded that fishing effort is mainly influenced by the fishermen's expertise and weather conditions, mainly rainfall. The CPUE reflected a successful recruiting processes for white bass in the studied fishing area in response to changes in climatic conditions.

## CONTRIBUTION OF THE ONBOARD OBSERVER PROGRAM OF THE PROVINCE OF CHUBUT, ARGENTINA TO THE BIODIVERSITY KNOWLEDGE THROUGHOUT BYCATCH ANALYSIS.

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Acuerdo de Trabajo entre la Secretaría de Pesca de la Provincia de Chubut, Argentina.

The bycatch control is a challenge for fisheries management and is particularly difficult in shrimp fisheries. In Argentina the Patagonian shrimp (*Pleoticus muelleri*) is a major export fishery, with highly variable landings in the past 20 years (two peaks 80,000 t in 2001 and 2011). The fishery, which accounts for 95% of reported shrimp landings, is carried out in a breeding area of hake (*Merluccius hubbsi*), where incidental capture is reaching 35,000 t/year, mainly juveniles. The bycatch control in the hake fisheries is the main challenge facing its management. However, a significant number of other species are also incidentally caught. This partial attention to bycatch of commercial species contrasts with the ecosystem approach to fisheries management where sustainability of all caught species must be addressed. This paper describes the bycatch in the shrimp fishery in Patagonian waters of San Jorge Gulf and adjacent waters (between 43° and 47° South). The information is collected by the Onboard Observer Program of the Province of Chubut (POBCh), which is headed by the Undersecretary of Fisheries of the province and has the technical support of the Faculty of Natural Sciences (FCN), Universidad Nacional de la Patagonia San Juan Bosco. Observers identify in each fishing haul the harvested species at the lowest possible taxonomic level. For each taxon is recorded abundance in number in five categories (dominant, abundant, common, rare and very rare) and destiny (entirely, partially or fully encased and thrown into the sea). Training for species identification requires a major effort. This task was carried out by the FCN, who implemented a permanent training program for almost ten years. Since 2003 the list of recognized species has reached 117 (2 hagfish, 28 chondrichthyes, 59 teleost and 28 crustaceans), 4 are categorized as “endangered” and 4 as “vulnerable”. The bycatch assessment allowed us to broadening the knowledge on biodiversity on the region, and expanded the knowledge on the distribution of 22 species. In addition, the collected samples gave rise to a ichthyological collection at FCN, which is now part of the “National Network of Biological Collections of Argentina”.

## SURVEY OF BIODIVERSITY AND BIOLOGICAL INFORMATION OBTAINED FROM CHONDRICHTHYAN BYCATCH ABOARD OBSERVER PROGRAM IN THE PROVINCE OF CHUBUT - ARGENTINA

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In the Argentine Sea over a hundred species of cartilaginous fish are caught by directed fisheries or as bycatch by commercial fleets, craft and also sport fishing and recreational. Given the characteristics of living *chondrichthyans*, they respond quickly to environmental effects and adverse anthropological presenting prolonged periods of reaction to the conservation and management measures. Growing concern for the status of some species of sharks and rays led to their inclusion in the appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Migratory Species, based on reports produced by International Union for Conservation of Nature (IUCN). The IUCN list includes several species of the Argentine Sea in different categories. For this reason IUCN has promoted the implementation of programs for the collection and evaluation of biological data and marketing of listed species, resulting in the development of the National Action Plan for the Conservation and Management of *chondrichthyans* (sharks, rays and chimaeras). The overall objective is to ensure the conservation and sustainable management of *chondrichthyans* in the areas under the jurisdiction of Argentina following the guidelines of the Code of Conduct for Responsible Fisheries of FAO and the ecosystem approach to fisheries management. Since 2001 the province of Chubut has fisheries monitored (between 43° and 47° South) by the Board Observer Program (POBCH). The program not only gets information from the target species, but also of

all species caught, with the goal of advancing an ecosystem approach to fisheries. Since 2010, recognizing the need to advance the understanding of the biology of *chondrichthyans* caught by fleets POBCH monitors, work began on the training of observers and to develop a working protocol for the collection of *chondrichthyan* biological information that was possible to carry out on board fishing vessels.. There has been the capture of 29 *chondrichthyan* species (10 sharks, 18 batoids, 1 chimera) of which four species identified are categorized as “at risk” and four as “vulnerable” by the IUCN. This survey helped to identify *chondrichthyan* diversity of the area and expand the knowledge of the distribution of 7 species batoids. Moreover, biological information obtained shows that fishing takes place in areas in which specimens’ congregate newborns, juveniles and adults. It is extremely important to maintain the continuity of these surveys to monitor the population dynamics of these species.

## GREEN STURGEON AND CALIFORNIA HALIBUT: USING AND IMPROVING OBSERVER DATA TO MANAGE RESOURCES

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The California halibut trawl fishery is a small but important commercial fishery in central and southern California. However, managers currently lack sufficient data needed to make decisions regarding management of the fishery and of bycatch. One bycatch species of particular concern is green sturgeon (*Acipenser medirostris*). The southern distinct population segment (DPS) of green sturgeon was recently listed as threatened under the Endangered Species Act. We discuss how the observer program provides a unique, cost-effective opportunity to gather needed data to inform effective management decisions in this fishery. The green sturgeon is a slow growing, late-maturing, long lived species with a complex life history that we don’t fully understand. They spawn in large river systems, rearing in the rivers and estuaries for 1-4 years before heading out into marine waters, where their movements vary greatly. Green sturgeon are known to range from California to Alaska, using coastal estuaries from northern California to Washington, and returning to freshwater to spawn every 2-5 years after reaching maturity. They are regularly caught as bycatch in the California halibut fishery, especially near the mouth of the San Francisco Bay, which is the entry and exit point of the southern DPS’s only spawning grounds in the Sacramento River. Observers make a significant contribution by providing one of the only sources of information on green sturgeon bycatch. Since 2007, observers have collected significant data on this species. These data are being used to assess the magnitude and significance of this bycatch to the Southern DPS and, over time, can be used to develop management measures. Future expansion of sampling studies can also be made to take advantage of observer interactions with this resource. For example, plans are in development to explore tagging by observers, as a useful way to learn about fish movement, mortality rates and even population estimates. The observers also provide valuable, consistent data to inform management of the California halibut fishery to protect and sustain the fishery. California halibut are a valuable resource with a complex life history which takes them in and out of open ocean and estuaries and bays, and their spawning grounds have not been completely identified. Through monitoring and data collection, observers once again have the ability to increase and improve the information available to managers to make informed decisions. Over time, these data will allow identification of temporal trends in the population’s abundance and distribution. The interaction of observers with the resource can also be maximized with the addition of tagging studies and additional data collections. In summary, observers have a rare opportunity to provide valuable information to inform effective management of the California halibut fishery and address bycatch of green sturgeon. This is a rare opportunity where, without incurring considerable additional costs, the management of several resources could be greatly improved by skilled observers performing their duties.



## *HOW CAN ACAP BYCATCH DATA REPORTING SUPPORT AN ECOSYSTEM BASED APPROACH TO FISHERIES MANAGEMENT?*

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<sup>2</sup> Subsecretaría de Pesca (SUBPESCA), Chile.

<sup>3</sup> Agreement on the Conservation of Albatrosses and Petrels (ACAP), Australia.

The Agreement on the Conservation of Albatrosses and Petrels (ACAP) is a multilateral agreement which seeks to conserve albatrosses and petrels by coordinating international activity to mitigate known threats to their populations. ACAP came into force in February 2004 and currently has 13 member countries (Parties) and covers 30 species of albatrosses, petrels and shearwaters. The ACAP Secretariat recently developed a web-based reporting system to collect and collate bycatch data from Agreement Parties and Range States. In 2011, twelve Parties and Range States provided data via the web-based forms, for a total of 79 fisheries. The information sought in the national reports includes the size of the fishing fleet, area of operation, observer programmes in place, total fishing effort undertaken, observed effort, and seabird bycatch numbers and composition, as well as any mitigation measures that were in place each year. This information is a vital step in the development of an Ecosystem Based Fisheries Management (EBFM) approach, as it improves our understanding of the level of risk of seabird bycatch in these fisheries and allows appropriate management measures to be put in place to mitigate these risks. We present the structure of the report and show the importance of the monitoring system in identifying the impact of fishing activities on seabirds.

## *MANAGEMENT MEASURES AND CHANGES IN THE AT-SEA PACIFIC HAKE FISHERY OFF THE U.S. WEST COAST RESULT IN ECOSYSTEM BENEFITS*

Tuttle, V.J.

NOAA/NMFS, USA.

The at-sea Pacific hake fishery off the U.S. West Coast has two sectors operating off the Washington and Oregon coasts: a mothership sector, which receives catch from a fleet of smaller catcher vessels; and a catcher-processor sector. NOAA's Northwest Fisheries Science Center administers the At-Sea Hake Observer Program which deploys two fisheries observers on each vessel for real-time data collection. Management measures and recent changes in the at-sea hake fishery have had the benefit of producing positive changes for the health of the fishery and the ecosystem in general. Some examples of this include: low bycatch quotas for several important bycatch species, which has led to a precautionary effect on fishing resulting in lower bycatch rates; regulations prohibiting bottom contact which protects against benthic habitat impacts; trawl rationalization program implemented, with individual vessel accountability for bycatch; U.S.-Canada treaty formally adopted to agree on division of total allowable catch and end overfishing of hake; and Chinook salmon bycatch threshold, which reduces impacts on ESA-listed species. In addition, while the at-sea hake fishery is a single species fishery, data collected by the observers in this fishery are currently used in seven different stock assessments. While we are still learning how to incorporate ecosystem benefits into our management and assessment methods there has been progress towards a healthier fishery and ecosystem.

## *THE RISE AND FALL OF HUMBOLDT SQUID BYCATCH IN THE U.S. WEST COAST AT-SEA PACIFIC HAKE FISHERY*

Tuttle, V.J.  
NOAA/NMFS, USA.

The at-sea Pacific hake fishery off the U.S. West Coast has two sectors operating off the Washington and Oregon coasts: a mothership sector, which receives catch from a fleet of smaller catcher vessels; and a catcher-processor sector. NOAA's Northwest Fisheries Science Center administers the At-Sea Hake Observer Program which deploys two fisheries observers on each vessel for realtime data collection, including species composition sampling for bycatch data. The surprising appearance of Humboldt squid (*Dosidicus gigas*) bycatch in the atsea hake fishery left scientists and fishers scratching their heads in 2004. The appearance coincided with the geographic range expansion of Humboldt squid in the last decade, both north and south along the North and South American coast lines. Various authors suggest the expansion is a result of changing ocean conditions coupled with Humboldt squid's ability to quickly exploit niches. From 1977 to 2003 the total bycatch of all squid species within the at-sea fishery was low, averaging just 0.08% of the total catch. From 2004 to 2007, squid bycatch increased from the historic average of 0.08% to 0.6%, with overall squid catch for this period averaging about 900 m. year<sup>-1</sup>. During this same period bycatch of all other species decreased to lower than average values. Beginning in 2006, following the recognition of Humboldt squid as the major component of overall squid bycatch in the fishery, observers were directed to identify Humboldt squid to the species level. In 2008, Humboldt squid bycatch rose to 2,800 mt or 1.5% of the total catch and then peaked in 2009 when 4,400 mt of bycatch were recorded, representing 5.7% of the total catch in the atsea hake fishery. This change in species composition and high level of bycatch meant the observers had to adapt to the sampling challenges they faced. The hake fishery has an historic overall bycatch rate of less than 2%, so this level of bycatch was unprecedented. In 2011, total Humboldt squid bycatch was just 11 kg and 2012 is shaping up to be a similar year. It appears the squid have left just as quickly as they arrived. Analysis of bycatch species composition for all years, comparing pre-and post- squid years will be presented.

## *FISHERIES OBSERVER ON BOARD TRAWL VESSELS: IS IT WORTH IT?*

Maravelias, C.D.  
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A fisheries observer sampling scheme has been applied onboard trawlers in North Aegean Sea in an attempt to identify factors affecting total and individual species' catches and spatiotemporal distribution of effort to fishing grounds. Fishery scientists' onboard observations alongside fish market recordings during the same period confirmed that each fisher has developed an individual decision-making fishing process. Fisher's trip choice behaviour was found to be modulated by several factors, such as distance of fishing grounds from the port, market demands (both in terms of species and market prices), weather conditions, alternative fishing strategies, previously gathered information, economic pressure and personal skills. These findings are discussed in the light of the need to incorporate additional quantitative information to stock abundance estimates if improved fisheries management scenarios are to be advanced.

## *USING MONITORING SERVICES TO INFORM THE PRECAUTIONARY APPROACH TO FISHERIES MANAGEMENT: AN EXAMPLE FROM THE BIOLOGICAL SAMPLING PROGRAMS IN AREA A OF THE BRITISH COLUMBIA CRAB FISHERY*

Barney, A.J.  
Ecotrust, Canada.

In 2013 biological sampling will begin in all crab management areas in British Columbia as part of monitoring requirements, and in 2012 a pilot program was run in Area A as part of their monitoring services. In 2012 the biological sampling was conducted by trained Designated Observers but due to the unique video monitoring that exists in Area A there is the hope that biological sampling can be audited by this system in order to allow some harvester collected data. Since Area A is a low-information fishery, an extensive survey design, one that collects less data per sampling event but has more sampling events covering a larger number of vessels and locations, should be more valuable than an intensive survey design that collects a large amount of data from a smaller number of sampling events. The unique video monitoring that exists in the Area A crab fishery can be used in conjunction with Designated Observers to better inform ecosystem based management by increasing the number of sampling events conducted without increasing the cost to the harvesters. The existing management system for the British Columbia Dungeness crab fishery is not one with Individual Transferable Quotas or a Total Allowable Catch, but rather is managed using a 'size/sex/season' method. Using this method the fishery is managed by only allowing large males to be harvested from the stock and, in Area A, by closing the fishery during the spring moult. Landings have historically been reasonably steady and until recently data collection for this fishery has been unnecessary. Fisheries and Oceans Canada under the guidance of ecosystem based management and the Sustainable Fisheries Framework, now requires biological sampling in this fishery to help make informed decisions under the Precautionary Approach. The biological sampling program collects data on both target and nontarget catch. The target species for this fishery is large male Dungeness crabs (>165 mm carapace width point-to-point), the non-target catch includes sub-legal males, females, soft-shell Dungeness crabs and any other species caught. The data collected from the biological sampling allows scientists and managers to determine the following information and use that information in decision making:

- Age class/size structure of crab stock
- 2. Discard ratio
- Moulting periods
- Year to year variations in stock size and composition
- Bycatch
- Impact of fishery on sensitive benthic areas

This case study examines how Observers provided the biological data in 2012 and how current electronic monitoring in Area A can probably be used to improve the monitoring program's ability to inform an Ecosystem Based approach to management.

## *ANALYSIS OF BYCATCH ON MAMMALS, TURTLES, BIRDS, SHARKS AND RAYS IN THE HAKE (*Merluccius gayi*) TRAWL FISHERY OF NORTHERN PERU.*

Céspedes, C., Kelez, S.  
Ecoceánica, Peru.

Bycatch studies contribute to the development of sustainable management and technological development to prevent mortality of non-target endangered species. In Peru these studies are very scarce, and in the specific case of the hake trawl fishery, a bycatch study has not been implemented to date. The objective of this study is to provide information on mammals, birds and turtles, which are being caught as bycatch in this fishery, to make recommendations to mitigate their capture and mortality. It also includes the group of sharks and rays, as there is a global concern about the limited existing scientific knowledge on the biology and ecology of these

species and bycatch impacts on their populations. The study was conducted between April and July 2009 by five Fisheries Observers on fishing vessels, covering 118 fishing trips with 670 fish hauls. During those trips 80 droll sea lions were captured mainly subadult males (*Otaria flavescens*), one bottlenose dolphin (*Tursiops truncatus*), 1 Cheloniidae turtle, 78 species of sharks *Mustelus* sp, *Mustelus whitneyi*, *Notorynchus cepedianus*, *Echinorhinus cookei*, *Galeorhinus galeus* and *Squatina* sp; 556 stripes vezezi Raja species, *Sympterygia brevicaudata*, *Rhinobates planiceps*, *Torpedo peruvianus*, and *Myliobatis Myliobatis longirostris* sp. In terms of seabird interactions, with the boats (*Sula nebouxii*), the blue-footed booby 20 individuals were entangled in the nets as they flew around it trying to remove the fish from the net and another 20 collided with the vessels. The CPUE was estimated at 0.12 mammals/haul; 0.001 turtles/haul; 0.12 sharks/haul, and 0.83 rays/haul. The percentage of marine mammal mortality was 75% and birds 28%. The results suggest that the sea lions, sharks and rays are highly affected by trawling and many of them are not considered as bycatch in fisheries legislation (especially sea lions and sharks). It is therefore recommended that mitigation regulations should be established on nontarget species.

## REVIEW OF SKATE BY-CATCH LEVELS AND TAGGING DATA COLLECTED BY CCAMLR SCIENTIFIC OBSERVERS

Miller, A.J., Reid, K.

Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR)  
Secretariat, Australia.

Elasmobranchs are caught, either as target or bycatch, in a range of commercial fisheries using a variety of bottom fishing methods including trawls, gillnets and longlines. In general elasmobranchs are slow-growing and have low reproductive rates and this has made them highly susceptible to the effects of overfishing. In addition, as 'apex' predators the depletion of their populations is likely to have a range of effects on other fish populations and on marine ecosystems generally. Skates and rays are taken as bycatch in the demersal longline fishery for the toothfish fishery in the CCAMLR area. Understanding the implications of this bycatch has been identified as a priority component of the ecosystem-based fisheries management approach implemented by CCAMLR. Measures introduced by CCAMLR to reduce skate and ray bycatch include nontarget taxa catch limits and move-on rules. Furthermore the data collection priorities of the CCAMLR System of International Scientific Observation have placed a specific emphasis on gathering data on skates and rays, including the 'Year of the Skate' in 2008/09. During this period biological data collection and tagging of skates and rays was given priority over all other bycatch and this has provided a large amount of data from areas where little or no research has been carried out on these taxa. The CCAMLR secretariat is currently undertaking a review of all observer data on skates and rays, which includes data from the Atlantic, Indian and Pacific sectors of the Southern Ocean. This review of observer data will assist in determining issues that may influence skate bycatch, such as bottom topography/depth of fishing as well as the correlation with catches of target species. In addition the review will examine aspects of species distribution, movement, recapture rates and susceptibility to hook injury induced mortality to provide a better understanding of the biology and ecology of these key components of deep sea benthic fish communities in Antarctica.

## MONITORING OF SUBLITTORAL BENTHIC COMMUNITIES IN THE AREAS OF MANAGEMENT AND EXPLOITATION OF BENTHIC RESOURCES (AMERB)

Oroza, C.

Instituto de Fomento Pesquero, Chile.

The management and Exploitation Areas for Benthic Resources (AMERB) are a saturated fisheries management regime in Chile since 1997. This measure gives exclusive rights management to artisanal fishing organizations on various benthic resources (eg: macroalgae, molluscs, crustaceans, echinoderms, urochordates) within a given area of the ocean floor. Since 2006, the Fisheries Development Institute (IFOP) annually

monitors the performance of a group of AMERB with special attention on resources: Loco (*Concholepas concholepas*), limpets (*Fissurella* spp), red sea urchin (*Loxechinus albus*) and stick-Kelp (*Lessonia trabeculata*). Monitoring focuses on biological and fishing indicators of each resource (eg: average density, age composition, etc.), but also involves the study of benthic communities that support AMERB target species. The benthic monitoring by IFOP comprises two distinct approaches to spatial scale and taxonomic resolution. The first approach aims to characterize the AMERB submarine floor, according to the different types of communities present (e.g., kelp forests, barren grounds, barnacles covered substratum, sponges and/or sea squirts, etc). This first approach requires systematically covering the entire AMERB, and therefore necessary to work together with local fishermen who rely on the diving work. The IFOP technical team trains local divers participating in the activity so they don't fail to recognize each type of community. The second approach is a high resolution taxonomic community study, focusing on the type of community with greater spatial coverage according to the results of the first approach. With this information we estimate ecological indicators such as the Shannon diversity, Simpson diversity, specific Dominance, Dominance K-index, etc. and test hypotheses to assess whether there are changes from one year to another. This assessment is carried out by scientific divers (marine biologists) who share knowledge in identification of macroalgae and invertebrates. So far, the results have been mainly descriptive, thus having identified 24 types of communities that are characteristic of shallow rocky bottoms in the north, north-central, south-central and south of Chile sublittoral. This list of different types of communities has been practical and is to be used in training the technical team of IFOP delivery to local divers. The sustained strengthening over time of this collaborative work has allowed IFOP analysts to develop AMERB mapping the spatial distribution and percentage coverage for each community.

#### GEOGRAPHIC, GEAR- AND FISHER-SPECIFIC DIFFERENCES IN CATCH COMPOSITION IN AN AUSTRALIAN COASTAL LINE FISHERY

Gray, C.

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Commercial line fishing is used to target a large diversity of demersal and pelagic teleosts and elasmobranchs on coastal continental shelves worldwide. In recent years, there has been much emphasis on identifying and quantifying discarded catches and interactions with protected and threatened species and habitats in such fisheries. In this presentation the rationale, design and results of an observer-based survey of commercial line fishing in eastern Australia are reported. Observers monitored and sampled catches from three main methods; longline, dropline and handline, in a stratified design across three geographic zones for two years. The data show that the retained and discarded catch compositions differ greatly among individual methods, with handlining and droplining primarily capturing demersal teleosts in shallow and deep waters respectively, whereas longlining mainly captured large sharks. Catch composition of each method varied geographically, among seasons and was dependent on the practices of individual fishers. There were few interactions with protected or threatened species. The data show that the different methods of line fishing need to be managed separately, and that current regulations need to be changed for the sustainable harvesting of fisheries resources in the region.

#### MAPPING AREAS AND TIME PERIODS OF HIGH PACIFIC HALIBUT BYCATCH: POTENTIAL PRODUCTS TO ASSIST FLEETS WITH VOLUNTARY BYCATCH REDUCTION

LaFargue, J.

NOAA/NMFS, USA.

In the past there has not been any incentive to target Pacific halibut by the West Coast Limited entry trawl fleet since Pacific halibut were prohibited from being landed. There also has not been an incentive to avoid areas of high bycatch areas of Pacific halibut, especially when there wasn't a fisheries observer onboard. This all changed with the start of the catch shares program in 2011 with its quota pounds, and 100% observer

requirement. The vessels fishing north of Cape Mendocino, CA were allocated Pacific halibut quota. Once a fisher catches their quota pounds they have to either purchase more quota pounds or stop fishing. Now there is an incentive to avoid Pacific halibut. The majority of Pacific halibut caught on LE trawl vessels both north and south of Cape Mendocino are now being accounted for with the increase to a 100% observer coverage. This gives managers more accurate estimates of total catch. By looking at observed Pacific halibut catch by poundage/numbers, date, depth, and area we can identify area/time periods of high bycatch. Through GIS we can map these areas to produce a usable product for managers and the fleet. Bycatch maps based on the past 12 years of Pacific halibut catch data collected by the West Coast Groundfish Observer Program, can easily identify areas and time periods of high Pacific halibut bycatch. This information can be used by the fleet to avoid these areas/time periods to voluntarily reduce their take of Pacific halibut. With the increased concerns over decreasing stocks, bycatch maps could be used to help achieve the common goal of voluntary bycatch reduction.

## SEABIRDS IN SHELLFISH FISHERIES

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Usually, the crustacean trawl fishery has been accompanied by seabirds that interact directly or indirectly with the vessel and is the case of albatrosses, petrels and shearwaters from Taltal to Talcahuano. These birds normally feed from bycatch attached to the capture. This presentation consists on photographic records of the sighted species from fishing areas where nylon shrimp (*Heterocarpus reedi*), Yellow Shrimp (*Cervimunida johni*) and lobster (*Pleuroncodes monodon*) are captured from the third to the eighth region of Chile.

## HOW CAN FISHERY MONITORING PROGRAMS SUPPORT AN ECOSYSTEM BASED APPROACH TO FISHERIES MANAGEMENT

Van Niekerk, J.

NOAA/NMFS, USA.

The Fishery Observer Program has been crucial in accumulating data for monitoring ecosystems, especially in the pelagic regions of the Northern Pacific Ocean. Due to observer tolerance to bad weather conditions and the understanding of the Open Sea, data which would be otherwise hard to come by have been recorded by very dedicated men and woman. The objective/s of Observers is to collect data that can be used to determine the effect of Conservation Laws governing, but not limited to, the commercial fishing industry. Data collection occurs in the form of collecting whole specimens (to identify natural history patterns) or organs of specimens (e.g. crucial in testing for certain amino acids which are used to identify prey items, sexual maturity and growth rates). The data is also used to find alternative or improved ways of fishing in order to prevent the capture of and protect non-targeted species such as Mammals, Birds and Turtles. A key preventative measure was the utilization of pingers which deter mammals from swimming into drift nets, based on their frequencies emitted which is unique to the various marine mammal species. Another prime example is the data used to determine Highly Migratory Species (HMS) diets which have been recorded for almost 20 years, highlighting a clear pattern in Pelagic Species positions in the food web. By focusing on core representatives from various animal taxa, a much broader view of predator-prey species interactions have been obtained. There are 2 specific species worth mentioning, namely Pacific Swordfish (*Xiphias gladius*) and Common Thresher Sharks (*Alopias vulpinus*). Both are important commercial species and make up the majority of pelagic fishing by vessels off the California coast. Pacific Swordfish are preyed upon by Short fin Mako Sharks (*Isurus oxyrinchus*) which constitutes a big portion of the latter's diet. Swordfish, on the other hand, are known to prey heavily upon Pacific Hake (*Merluccius productus*), another economically important species. The interactions of these various species are all affected by man. By studying the predator-prey interactions we could establish ways of managing our fish stocks more successfully thus ensuring productive fish stocks for future generations and limit competition between man, non-targeted and protected species which share common resources. It is important

to promote the Observer program on an International scale and build close ties with the World's major fishing communities. Results obtained will ensure the survival of fish stocks at a level sufficient to sustain the Global community.

### MONITORING PROGRAM OF HARMFUL PHYTOPLANKTON, MARINE TOXINS, AND ENVIRONMENTAL VARIABLES IN FJORDS AND MACROZONE SOUTH OF SOUTHERN CHILE

Guzmán, L., Vidal, G., Vivanco, X., Arenas, V., Palma, M., Iriarte, L., Mercado, S., Fernández-Niño, E., Monsalve, J., Pizarro, G., Pacheco, H., Alarcón, C., Espinoza, C.  
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In the last four decades, it has been observed worldwide an increase in the frequency, intensity and geographical coverage of the red tides that are technically called Harmful Algal Blooms (HABs). Chile has not been oblivious to these phenomena. The HABs correspond to a proliferation in aquatic environments of microscopic algae that can cause massive death of fish and a variety of other organisms, contaminate seafood with toxins, and alter ecosystems. The impacts on man and his activities, includes poisoning from seafood consumption, which can be fatal. In addition there has been mass mortalities of marine organisms in the natural environment and breeding and growing systems, alterations of coastal habitats and these events have caused disruptions in social and economic systems. The absence of antidotes for toxins, lack of technologies to control blooms in the environment or to eliminate toxins from shellfish, has caused disturbances in social and economic systems. In addition the lack of models to predict the onset, duration and place of occurrence of the blooms has forced us to have tools to counter these weaknesses, such as monitoring programs. These are understood as a systematic activity in space and time, oriented to obtain information to determine the natural tendencies of certain variables that can be used as indicators of environmental change and eventually as risk indicators to public health, the environment, and productive activities. In this case, these programs provide timely and reliable information which is an early warning. The three southernmost administrative regions of Chile, Los Lagos, Aysén and Magallanes, are affected more frequently and reoccur every year since the mid-2000s, although HABs have been known to occur in the Magellan region since 1972, and in the region of Aysén starting in 1994, and in Los Lagos region since 2000, in regard to *Alexandrium catenella* and paralytic shellfish poison. But there is evidence from other harmful taxa and other marine toxins. This change in the behavior of HABs determined since May 2006, the development of a phytoplankton, marine toxins and other environmental variables monitoring program, covering all three regions, to provide data and information for authorities decision making, and to achieve a better understanding of this phenomena. This presentation shows the structure and organization of the monitoring program, highlighting the features to achieve reliable and timely data, including the logistics to access the sampling points, sampling techniques, samples analysis, data analysis, and presentation and dissemination of results, considering the extent and geographical complexity and the need of local working groups in the regions covered by the study.

DOCUMENTARY FEATURETTE, OBSERVE THIS! PROVIDES OBSERVERS WITH A REALISTIC CONTEXT AND MEANS BY WHICH TO SHARE WORK RELATED EXPERIENCE AND ADVICE

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Because fisheries observers work independently out at sea and spend relatively little time with each other exchanging ideas and information are limited. This lack of discourse can in turn result in lost opportunities for observers to benefit and learn from the experiences of their colleagues. This 15 minute documentary featurette explores just a few of the challenges and other work related issues faced by current observers in the Pacific Islands Regional Observer Program (PIROP) as well as some of the methods these observers have used to deal with them. Using visual media and personal interviews to illustrate these experiences, *OBSERVE THIS!* serves as a unique way for these observers to share valuable information not just within PIROP, but to observers collecting data in other programs as well. Topics discussed include certain challenges regarding sampling methods and data collection duties, space constraints and other potential hazards typical to fishing vessels, maintaining positive working relationships with fishers' personnel, as well as issues concerning diet and personal health. Because these topics are not program specific and likely apply to some if not all other programs, observers can benefit universally from this entertaining and informative method of discourse. Furthermore, in hopes of improving the quality and extent of knowledge that fisheries observers have about their and others' programs and in turn promoting an increased level of professionalism, we propose that *OBSERVE THIS!* serves as an example for ways of initiating an ongoing and international exchange between observers within and across programs.

STUDY CASE: THE SCIENTIFIC OBSERVER ROLE IN THE MERLUCCIUS GAYI GAYI FISHERY, VIII-REGION, CHILE

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The fishery system – i.e. the social-ecological system surrounding the fishery that is at the core of the EAF (Ecosystem Approach to Fisheries) – is the starting point for defining the scope of the EAF. An EAF puts the fishery in a context of three main facets: its biotic components, its abiotic elements and its human dimensions, including social, economic and institutional frameworks and factors (FAO, 2010) (page xvii). The fishery system is a social-ecological system, and consists of linkages between people and the environment, also outside the actual operations (page 15). One of the many species Fisheries Scientific Observers (FSO) carry out a follow up sampling program in Region 8th is *Merluccius gayi gayi* fishery. This fishery is part of a fishery system characterized as a controversial and turbulent network of interaction embedded in a Social-ecological system (SSE) much greater and complex than the fishery system itself. Since Fisheries Scientific Observers are the first and most important link in the fishery knowledge management value chain of *Merluccius gayi gayi*, it is worthwhile the effort of describing their experience accumulated *in situ* while performing their role in the fishery. The purpose of this presentation and poster is: 1) To describe *Merluccius gayi gayi* processes, 2) Identify the key problems that obstruct the FSO work fulfillment at the present time and 3) Suggest viable solutions to key-problems within the context of recently enacted Law Number 20.625 dealing with fishery discards.



*RATIONALIZING THE IRRATIONAL: MANAGEMENT CONSIDERATIONS FOR AN OBSERVER PROGRAM TRANSITIONING TO A MULTI-SPECIES INDIVIDUAL FISHING QUOTA SYSTEM. LESSONS LEARNED FROM THE RATIONALIZATION OF THE GROUND FISH FISHERY OFF THE WEST COAST OF THE US.*

McVeigh, J. <sup>1</sup>, Benante, J. <sup>2</sup>

1. NOAA/NMFS, USA.

2. Pacific States Marine Fisheries Commission, USA.

The rationalization of the limited entry trawl fleet to a Catch Share (CS) management system on the West Coast of the United States occurred on January 11, 2011. This created sweeping changes to the management of the fishery. The fishery became an Individual Fishing Quota (IFQ) fishery for 62 different groundfish species. To track these quotas, fisheries managers implemented 100% observer coverage at sea and 100% catch monitor coverage for all landings. The increase in observer coverage in the rationalized fishery occurred while maintaining observer coverage levels in a variety of other fisheries observed by the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Hake Observer Program (A-SHOP). These requirements had direct and meaningful impacts, in a number of ways, on the WCGOP and A-SHOP and how the programs are managed. The multi species quota system required shifting observer priorities and data timelines to accurately account for discarded catch of quota species for in-season reporting, while maintaining the collection of meaningful data on non-quota species to inform science objectives. The 100% observer coverage requirement had a dramatic effect on staffing and workloads for the WCGOP. Staff levels increased some, but not at the same dramatic rate that observer numbers and data collection increased. Five times more trainings were conducted and over 130 new observers were trained during the first year of the program. Maintaining and building upon the safety advances the WCGOP has achieved in the past ten years has been an ongoing challenge since ensuring the safety of observers and achieving 100% coverage can be counterproductive. Additionally, the observer program continues to explore cost saving alternatives to monitoring the fishery such as electronic monitoring. Large efforts like this require coordinating and collaborating with other agencies, fisheries groups, programs and stakeholders creating both opportunities for advancement and challenges to meet all the needs of the groups involved. Database needs and capacities were reevaluated as well as observer gear such as scales. Data products and reports generated by observer program scientists were augmented to handle the new level of coverage and sampling changes. While the CS program has been successful in many areas, the WCGOP continues to identify and act on improvements to the observer program management and administration. This poster will explore the web of issues that face an observer program undergoing significant changes and discuss insights gained from the rationalization of the west coast groundfish fishery of the US.

*INVESTIGATING POST-RELEASE SURVIVAL OF ISTIOPHORID BILLFISH IN THE HAWAII-BASED LONGLINE FLEET: AN EXAMPLE OF COOPERATION AMONG FISHERIES OBSERVERS, INDUSTRY, GOVERNMENT AGENCIES AND ACADEMIA*

Stoehr, C. <sup>1</sup>, O'neill, F. <sup>1</sup>, Moyes, C. <sup>2</sup>, Bremer, K. <sup>2</sup>, Kelly, J. <sup>3</sup>, Musyl, M. <sup>4,5</sup>

1 Oceanic Environmental Consulting, USA.

2 Department of Biology, Queen's University, Canada.

3 NOAA/NMFS, USA.

4 University of Hawaii, USA.

5 Pelagic Research Group, LLC, USA.

Estimating post-release mortality of large pelagic bycatch species is critical to managing fisheries from an ecosystem based approach. For catch-and-release to be a viable management strategy there must be a high likelihood of post-release survival. As discards represent a significant proportion of the spawning biomass, determining their mortality is a management priority as established by the Magnuson-Stevens Fisheries Conservation and Management Act. Designing appropriate methods and tools to estimate survival is essential for establishing appropriate conservation techniques. Accurate estimations of mortality are challenging to

derive because of logistics, cost, experimental design, and obtaining sufficient samples. Although they are the right tool to indicate post-release mortality, the cost of pop-up satellite archival tags (PSATs) precludes their widespread application. Moyes and colleagues introduced a cost-effective biochemical approach that reduces experimental bias, increases sample size and would therefore optimize experimental design. We report the results of a survival study of striped (*Kajikia audax*) and Pacific blue marlin (*Makaira nigricans*) involving the cooperation of industry, federal fisheries agencies, university scientists and fisheries observers using minimally invasive state-of-the-art biochemical methods and PSATs. To circumvent the problems of collecting sufficient sample sizes, cooperative efforts between crews of fishing vessels, government agencies, fisheries observers, contractors, and academia is not only vital but it represents an effective means of reducing costs. Since September 2010, the Pacific Islands Regional Observer (PIRO) program has been gathering biochemical samples and deploying PSAT tags as part of a post-release survival study on marlin involving scientists from the University of Hawaii, NOAA Fisheries and Queen's University. Though the techniques and sampling protocols are minimally invasive, one requirement of our sampling methods is that the observer must be well trained to process and store multiple biochemical samples in a timely and fastidious fashion; sometimes during adverse sea conditions. In addition, fisheries observers have provided critical input by further designing sampling strategies and gear that can be used onboard a wide range of fishing vessels with minimal impact to fishing operations. While previous post-release mortality estimates for Pacific blue marlin have been reported on sport fishing vessels in the Hawaiian Islands, these estimates do not necessarily translate to the commercial longline fishery due to many factors associated with longlining (e.g. hook type, time spent hooked on the line, leader material, fish size, and handling and discard practices). Although chartering commercial vessels would be the most efficient approach for sampling, it is also cost-prohibitive. Using the fisheries observer program for the majority of field work has provided high quality data at an affordable cost. By providing seasoned observers, PIRO and the contractor for the observer program (Saltwater Inc.) have presented observers with a unique opportunity to engage in meaningful, cutting-edge science that is critical for management while also providing valuable outreach to vessel owners and captains. Furthermore, having a direct link between observers and researchers has proven to be crucial in the success of this project.

# Closing Session

Recommendations for the future – What progress has been made since these conferences began and where do we go from here?



## Closing Remarks from Gabriel Blanco

Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), Argentina.

Oscar and the steering committee have asked me to prepare some thoughts on the conference. I am fortunate to say that this is my fourth conference, and wanted to leave the question open as to whether this is really a closing session or is it a new beginning.

A few days ago Luis Cocas gave us a brief overview of the history of the conference and I wanted to highlight and make a brief mention that what we see today is an international recognition for observers worldwide. A country or regional organization seeking to have an integrated monitoring system must have an observer program and the information collected should be available so that governmental entities can make decisions on fisheries management and fisheries systems subject to exploitation. The fundamental objective is to provide the information, reduce uncertainty so that research scientists and the political sector can establish plans of sustainability. Having trained observers on fleets allows us to obtain information such as catch, catch per unit effort, bycatch, discard, and is also an unsurpassable opportunity to communicate with stakeholders, fishermen, and captains.

Another thought and I repeat this just as a personal point of view, is to recognize all scientific observers of the world as professionals. They are very skilled and highly specialized. Those of us who were observers are now lucky enough to manage a program, be in contact with contractors, and government sectors. As Oscar said, "*If you do not know our work area, you will never know the value of it.*"

Being able to participate in these meetings throughout the years has shown me how the contents have expanded in comparison to the first one back in 1998 where we barely knew that there was an observer program. It has really grown. This year's conference established important debates in relation to electronic monitoring which I think is a tool that we cannot refuse to use. I think many electronic monitoring tools can facilitate the observers work onboard. It is up to us to capitalize on this. In no way should we separate the waters but instead work as one and allow for the continuous growth of this activity. The requirements once met years ago are different from now, they are constantly changing and I think many of the working methods presented here are following these adjustments.

I want to take a short pause on "the fisheries ecosystem approach". I think we have a unique opportunity of databases collected by observers that can be applied to this approach. We know that there are three dimensions: Ecological, Social and Economic. The intersection of the economic – ecological dimensions should be feasible, if we face this activity from a conservationist point of view, simply not permitting the extraction of natural resources based on its mere preservation, the approach will most likely tend to fail. We have to remember that the fishing industry is a big business; therefore it is our goal to maintain these activities sustainable over time by compensating both the ecological and economic approach.

The social and ecological approach is also intersected and it should be somewhat tolerable if one thinks about what Teresa Turk showed us in the country of Liberia where they are forming new observer programs. It is clear that they do not have an industrial activity but instead work for a matter of survival and food quality.

These points are fundamental to many countries of the world. We have to keep in mind that almost 20% of the world's population relies on fish as a protein source. The intersection between social and economic should also be equal; it is useless if we have on one side economic groups as part of a country's wealth and on the other people dying of hunger. Sustainability arises from the combination of these dimensions.

There is another issue that caught my attention and would like to mention. Many times the term "cost reduction" was used in this conference, in terms of having observers on board and how we can lower the costs. This is just a personal point of view. I think we should not speak of costs but instead of investment. Having observers at sea collecting data is an investment, not a cost. It is something that we are placing for our own future and the future of next generations. Always keep in mind that the greatest resource (no matter how friendly dolphins are or how charismatic birds can be) is the human resource, we are the main resource.

Having this said, I would now like to mix a few terms: Instead of "ecosystem approach for fisheries management we'll say "An observers approach in the observer program management". The only thing I switched is the ecological dimension for the dimension of the data and I believe these two as we previously saw on the ecosystem approach could be accommodated to observer programs and what to expect from observers. Evidentially the contact between the data and the observer's social environment must be tolerable; we cannot send observers to collect data in unfavorable conditions, which sadly we have seen too often. The intersection between the economic and data approach must also be viable. We have to properly invest to get the most out of the data. The economic and social approaches must also be equitable. We must figure out a way to solve many of the problems we face. I think Chile and Argentina are on a good path. We must try to incorporate the observers into the productive chain and see how we can achieve stability in this job. The confluence of the three dimensions will favor the sustainability of observer programs. I always tell my students that being an observer is not just a job, it is far from working at a home depot or serving drinks in a bar, this is a real *way of life*.

Before I finish I would like to point out a phrase from the French philosopher, Francois Dubet, who said: "*The model for equal opportunities has enough cruelty, because for the winners to deserve their victory, the losers have to deserve their defeat*" This phrase struck me because it is our mission as a species, as human beings try to help the less fortunate in every way possible not only economically, but socially in culture and development. I always tell my students *it's like having a race with two motorbikes, the first one with a big engine and the other with a small one. The one with the big engine will run on its own, thus we don't need to help it. It is the smaller one that will need all the possible attention in order for it to finish the race*. Having said this, I wanted to emphasize that the mission for all of us who are participating in this conference, is to try to give a hand to those who are starting a program and are in need of support, it does not have to be financially, sometimes just saying "guys you are doing a good job" will do. Many times that word of encouragement coming from developed countries serves as government management tools for second and third world countries. We must do what we can to help our colleagues, as we said last night this is a great family of observer programs from around the world and I think it is our obligation to help each other.

I also made recommendations and suggestions regarding the conference:

1. I would like to see a plenary session including both the social and economic dimension in relation to the ecosystem approach of fisheries management. The conference held in Portland had many interesting presentations regarding those topics and I think they were missed in this one.
2. Teresa Turk showed us how to support emerging undeveloped observer programs by bringing them to the conference. We must try to see how our organizations can financially support these incipient programs and capitalize their experience. We must keep in mind that it is not easy for them to participate in these events.
3. It would also be interesting to establish a permanent website where you can upload all conference presentations, posters, panels so they can be kept online over time and not just online for a few months. I had this experience at the conference in Galway, Ireland, today the site remains, the presentation and posters are still available, I find very interesting the fact that our presentations can persist over time.

4. I also wish that we had in the conference a space dedicated for recommendations. We had very interesting ideas here, and I think it's very important that the recommendations and suggestions should be kept in some sort of record within the conference, apart from the proceedings I think we should create a kind of book that can gather up these suggestions & recommendations and have it available for download.

5. This conference will surely have a positive effect on the possibilities to exchange experiences and knowledge. I believe it is essential that this conference supports these trades. It should be the conference's job to support formal and informal networks that may emerge from these meetings.

6. Finally I would also like to suggest that all conferences must have simultaneous translation and ask again for a round of applause for the translators here present.

I would like to add a few short announcements that I think are important. Oscar and I have been working for quite some time now on managing issues involving both Chile and Argentina. We have common resources and always had the vision to combine efforts and standardize procedures. One of the ideas we had was to generate an agreement between IFOP and INIDEP for capacity building, technological exchange of knowledge and experience between the two programs. Another thing we have been working with Oscar and many others is the idea is to build a permanent network of Latin American scientific observers. This is something that began back in 2007 in Victoria BC along with Martin Hall, Alvaro Segura and many others who showed interest building this network between countries that have many things in common including language and often idiosyncrasies.

The Argentinian chancellery has several funds available for bilateral exchange. I think that this is a tool we have to exploit. On the other hand, CONICYT from Chile has an excellent virtual training platform and also believe that we must use it to generate training within observer programs already established in Latin America and thus unify criteria and standardize protocols.

Thank you very much for your time.



## Closing Remarks from Lara Manarangi-Trott

WCPFC, Micronesia

Good afternoon and thank you to the Steering Committee and Oscar for allowing me to provide some thoughts on the 7th IFOMC as a first time participant. My name is Lara Manarangi-Trott, and I am currently the Compliance Manager of the Western Central Pacific Fisheries Commission (commonly known as WCPFC).

As the Compliance Manager, I am a person that uses the data collected under fisheries monitoring programmes including that collected by observers, to support conservation and management efforts of Commission members; this presentation here comes from that perspective. Throughout this conference there has been some reference to the WCPFC observer programmes, and I have seen in many of the presentations made this week similarities and some differences with the circumstances in the Western Central Pacific. What I intend to do in this presentation is outline some of the messages that of the 7th IFOMC which I will take back to the WCPFC. The Western Central Pacific Fisheries Commission was established in 2004, and the objective of the WCPF Convention is to look after and make sure that the tuna and billfish fisheries of the western central pacific are with us for a long time; that they are sustainable and effectively managed.

Pohnpei in the Federated States of Micronesia is where the WCPFC is headquartered. The IFOMC refers to me as being from Micronesia, but I'm actually a Cook Islander. Both countries are located in the middle of the Pacific Ocean; Pohnpei is just above the equator and Cook Islands is more southern. The current Chair of the Commission is Dr. Charles Karnella from the United States and Professor Glenn Hurry from Australia is the Executive Director.

The WCPFC looks after the biggest tuna fisheries in the world. The Federated States of Micronesia is that little star we see on the map (Refers to PowerPoint presentation), so we've travelled a long way to come to this conference. The Convention Area for the WCPFC includes a large number of Pacific Island countries waters, which are small island states that are interspersed with small areas of high seas waters in between them. Of particular note, is shown inset (refers to PowerPoint presentation), this highlights the seven members of the Parties to the Nauru Agreement (commonly known as PNA). The PNA members' national waters supply about 40 % of global canned tuna. So in the Western Central Pacific there are a lot of the tuna fisheries which occur within national waters, and so with the multiple countries involved there's a whole lot of interesting issues that come into play when fisheries monitoring and management measures are being developed. This comes out most clearly in the design of the WCPFC Regional Observer Programme which was built using the pre-existing national observer programmes of many of the small island developing states of the region and was designed to create employment opportunities for Pacific Islanders. But the Western Central Pacific is one of those areas where there are some quite unique features and these characteristics do need to be taken into account. Sitting through this conference, I and my two colleagues from the Pacific Islands region have been considering how some of the ideas and the work that you are doing in your parts of the world would apply to our region. A Commission meeting has 43 seats at the table; 36 Member countries; 7 Participating Territories and 11 Cooperating Non-Members: decision making is done by consensus. In 2011 approximately 2.25 million metric tons of tuna and billfish catches were taken by fisheries in our region, which was just over half of the world's tuna catches (55%). Eighty to eighty-five percent of catches within the Western and Central Pacific region are taken from within areas under national jurisdiction or EEZs. The Western Central Pacific region is significant globally, and tuna fisheries like in this part of the world are a really important way of life for Pacific islands currently and expect so into the future.

The fisheries themselves are still in good shape but we've got some issues to address. At the moment we have got a situation where we've got some quite well established fisheries monitoring procedures. We've got a long system through the Secretariat of the Pacific Community where my colleague, Peter Sharples is from, which has for many years assisted Pacific island countries with collecting logbooks from vessels they license to fish in their waters, as well as to develop their national observer programs. There's also very well-established procedures and standards for monitoring of landings and in port transshipments. These fisheries monitoring arrangements were pre-existing and continue since the establishment of the Commission, and the Commission has adopted complementary flag state reporting requirements observer coverage is something that has developed quite quickly especially in recent times. We've got 100% coverage on all purse seine fishing vessels. Since July 2012 we have 5% coverage on all longline vessels and 100% observer monitoring on high seas transshipments activities. There are approximately 720 observers, which are coordinated through the Western Central Pacific Fisheries Commission Regional Observer Programme, this is where my fellow WCPFC staff Mr. Karl Staisch comes in, he is the WCPFC Observer Programme Coordinator. Most observers come from Pacific Island observer programmes. The data that observers collect is entered through a centralized arrangement and this mostly occurs through services provided to the WCPFC by the Secretariat of the Pacific Community (SPC-OFI).

With some of that background, I will now shift to providing an overview of some of the take-home messages from the 7th IFOMC.

First, I found that this particular forum was really useful as a forum that brings together experienced observers, observer providers, national and international agencies, fisheries industry NGO's and a whole range of interested people who are working in this area. The 7th IFOMC provides a forum that it is a really useful way of talking about and celebrating the work that observers do. The forum does lend itself to discussions and collaboration between this broad range of individuals on observer standards and training, observer work conditions and safety, and observer programme design. I did find the whole discussion really useful and I'm hoping that WCPFC might have the opportunity to come to future meetings and continue to participate in those sorts of discussion and be able to contribute in ways that we can. So as a suggestion, and like my previous speaker, I think there is a real opportunity here for a lot of the experience and ideas that are discussed in this forum to be shared with more developing countries, particularly Pacific island developing countries. For example, the presentation by Teresa Turk on the development of the Liberia program as well as presentations

from other parts of the worlds, like Indonesia and South America. These national experiences from observer programs that are at different levels of development are ways that IFMOC can spread the word. As a suggestion I would like to propose that future IFMOCs explore ways to enable greater participation of developing country observer programmes and their observers. The IFMOC could provide an opportunity for expanded learning and sharing of international experiences, both from and with developing countries. It also would provide excellent networking opportunities between many different observer programmes. So I'd really like to congratulate the conference organizers on this particular aspect of the program during the 7th IFOMC and I look forward on seeing what the next step might bring.

Second, there are a number of emerging developments in fisheries monitoring in the Western and Central Pacific, and consideration is presently being given to Electronic Monitoring and Electronic reporting in some of our fisheries. How these work with observer and data collection programmes is one of the current considerations. As I mentioned earlier, we have a number of Monitoring Control and surveillance tools that provide support to Members MCS activities and collect a range of fisheries information: observers are collecting fisheries information, including information that can be used for compliance, WCPFC has a centralized vessel monitoring system (VMS) with a feed of data coming from vessels directly into our offices in Pohnpei. We've got a lot of high seas transshipment reporting and a high seas boarding and inspection programme. Access to this information is governed by procedures which provide a mechanism for WCPFC collected data to be used to support members fisheries monitoring and compliance activities, including in high seas areas. The WCPFC also has a developing compliance monitoring scheme, and we pull in as much of the information as we collect, to produce a compliance evaluation report for each of the 43 countries on their each year, this is intended to help to improve and make WCPFC fisheries management more effective. Under the compliance monitoring efforts, we are looking at ways to integrate the range of WCPFC data and information sources, and looking at ways we can get data input more effectively and whether or not real time data is what we need. Currently WCPFC is soon entering into a study that's starting to look at a review of what type of Electronic Monitoring is being done, and this is intended to inform WCPFC consideration of potential applications of electronic technologies in supporting scientific efforts and compliance monitoring in WCPFC fisheries. We are hoping that this will inform some very useful discussion within the commission context about how to move forward and make the best use of these technologies in a complementary way. In this respect, the demonstrations of new technologies during 7th IFOMC, both during the tools of the trade session as well as during the coffee breaks were very interesting. I did see that there are some electronic tools that are being used currently and are planned to be used and being used very effectively in a range of various different fisheries and a number of different purposes. I didn't get the chance to see the Ipad application tools that were around, but from what I saw during the presentation it was something that suggests to me that it is only the start of where we're going with electronic work. I also like the idea that electronic tools don't replace the important contribution that observers make to fisheries management, but there are ways to complement their work and which provide tools that both support observers and allow for activities to be monitored, particularly in areas and circumstances where it might not be possible for an observer to be all the time.

The traceability work that was shown earlier in the week was something that I found really interesting, particularly with the compliance monitoring work that we are doing. As a take home message, industry data can and is being used in rights-based fisheries management, and there are a range of experiences from around the world of ways that some of the industry data and the industry initiatives are being used to complement various fisheries management programmes.

From the discussions on the transshipment observer programmes it is clear that multiple international jurisdictions does add some complexity. But, there are some success stories and I think, like I said through forums such as this, there are number of ways that people who have a lot of experience and ideas can come together and find ways to continue to work together and collaborate. For example, the observer cross endorsement project that WCPFC has been working in partnership with IATTC establishes an arrangement for seamless observer coverage between the two halves of the Pacific Ocean. During 7th IFOMC, there were presentations as examples of transshipments cross endorsements between ICCAT and IOTC and of international funding and training of observer programmes in countries like Liberia.

I like to thank everyone who is contributing to this conference, to the steering Committee for making 7th IFOMC possible, to Oscar you and your team, thank you for your hospitality, I've enjoyed both the wine tour and city tour which were arranged for IFOMC participants - it was much appreciated. Thanks also to the presenters and conference participants for contributing their research and ideas during this conference, the interpreters for their excellent skills. Muchas Gracias.



## Closing Remarks from Omar Yáñez

Scientific Observer, Instituto de Fomento Pesquero, Chile.

Before I begin I want to apologize for not bringing a presentation, just a few thoughts that I would like to share with you. I would also like to thank you for choosing me as "Best poster" even though I did not have the chance to taste the prize!

In this corner of the world we have an artist named Ricardo Montaner, who interprets a song that says "*The southernmost settlements in the world right after the mountains*" and that is exactly where we are today, between the Andes mountains and our Pacific Ocean, specifically in Viña del Mar, which by the way, I hope you got to enjoy very much.

Some may think that we are concluding with the Fisheries Observer and Monitoring Conference and I'm pretty sure that they are right, but there are others who believe that this was more than that, they believe that something special happened here, something substantial, a concentration of knowledge that involves both management and technology, focused towards the sustainability of fisheries resources, but most important a concentration of people that despite bad weather conditions and political mismanagement are still able to complete their assigned tasks and stay strong with their commitment.

We conceive that there is no technology that can replace the perspective, contact, instinct and feeling that drives women and men not only to obtain biological fishery data but also to observe birds and mammals as they are being victims of the unconsciousness and greed that surrounds our job.

In these five days we have learned about the future, about new technologies and observer programs. We learned that there's a little guitar called "*ukulele*" which is a wonderful instrument, but also learned that not only our studies, degrees and research unite us, what really unites us is a resource-preservation spirit, our economic difficulties, health policies, things that we have all come upon. We revalidate that there are more observers concerned about the unification and welfare of their peers, observers that spend their time and effort in pursuit for the care of others.

Thank you very much for the International Observer Bill of Rights, thank you very much to the APO and their constant concern for the work of the observer. I also thank IFOP's Union. We may not be considered in published papers, perhaps our financial situation does not reflect our effort, but our reward comes from another path. I personally feel our profit goes beyond this; we have earned our respect, a respect from research managers and our peers. I believe that despite our cultural differences and languages we have become more unified. We are stronger now and hopefully will not break apart; on the contrary become more energetic and not let borders or distances end with these meetings that we now celebrate for the seventh time. Thank you very much to the oral and poster presenters, the knowledge delivered by you is invaluable, a big thank you goes to all attendees but specifically to the observers here present.

From the furthest corner of the world please take our affection to your families and especially to those observers who were unable to attend but were faithfully represented by all of you. Tell them that we know of their achievements and difficulties and that our course is now marked with convincing and comforting waters. Tell them that technology will never replace them, they are much too important. Express to them that we Chilean Observers respect their work and recognize their strength, and not to forget that if there weren't anyone willing



to work onboard, authorities would not be able to make decisions for the sustainability of fishery resources. Observers are not only the foundation of data collection plans, but also of an ecosystem that relies on their courage and commitment.

Thank you very much and God bless you all.



## Closing Remarks from Oscar Guzmán

7th IFOMC Chairman, Instituto de Fomento Pesquero, Chile.

Man has visualized the term “quality” through statistics ever since Taylor and Ford’s industrial revolution, in which man becomes an element of the production chain, brilliantly represented by Charles Chaplin in the film “Modern Times”.

I believe observers are in the data production chain. If we were to take their capacities, their implicitly gained knowledge and capitalize it by incorporating them to the earlier stages of decision making, we would surely have a significant amount of positive feedback. As I said before, IFOP’S 165 observers’ average seniority is 5 years and some go up to 25-30 years. They are more than professionals, even more than a PhD, for them, it has become a way of life, and they cannot be left behind nor ignored. Quality is one.

What moves us towards quality? Over the week we have talked a great amount on statistics. Years ago we would only mention the coefficient of variation and coefficient error on the averages. Back in the 90’s, system managers began to see that our field was far more complex. It was multidimensional, where the coefficient of variation and the statisticians were an element among many, and where the human element became fundamental. Quality is a human conception. Mankind is an endless chain of negotiations between ones needs. Relationships such as marriage, father-son, worker – boss, all represent this conception. In our field we observe the same chain. Sadly we look at this concept as a closed box. Strategic points of views, policy makers, political aspects, researchers and scientific observers’ are all isolated from each other. This is a social problem. It is the person who has the real knowledge and is able to transmit it through conversation and understanding. It is inconceivable to have no communication between research scientists and scientific observers. We cannot allow this to happen. Three years ago IFOP was able to visualize this and began to integrate delegates from the Undersecretary for Fisheries and Aquaculture, researchers and observers at annual meetings, where we would all analyze the data, agree on what we want to achieve, how we are going to accomplish it and if we are willing to do it. It’s one thing to say “yes, I can do it” but another is to really go through the process. After many years of experience I can tell you that the information can be manipulated as much as you’d like and assure you that a debriefing will not detect it. So I think in future IFOMC’s, we need to integrate a session for “Knowledge Management”, which is the science of transferring the needs of one group to another, knowing what you have and how to transform it into what I need in terms of intellectual capital.

If an institution does not function as a cell, if its strategic, operational, administrative and human relations do not operate as a whole, with goals in common, there will not be intellectual capital. It is nonexistent. This concept should not only be applied internally, but also among fellow institutions. There must be an open and honest conversation. Communication is the key. Institutions have a social approach, especially those that generate knowledge. Our goals and objectives will not succeed if we are not convinced that our product is really good and serves to make decisions that lead to the conservation of resources.

So in the next conference I think one of the topics should be “How to develop social relationships within the fishery system and how to improve communication aspects within the institution, between fellow institutions, and between fishermen and scientists.” This is not a minor issue, it is extremely complex and that is why we

have communication specialists. Sociological, intellectual capital and knowledge management are key aspects that I have not heard on other meetings. We are totally deficient of it.

Secondly, I'd like to focus on the importance of the observer as the first person who is in direct contact with the reality we intend to interpret. Science begins at this stage; it does not begin with data analysis or publications. That is just the formal part of science. The less formal part begins at sea, where the observer has to face the difficulties and challenges of being onboard. He (she) has to have the ingenuity to deal with uncomfortable situations such as convincing the reluctant captain and crew or avoid being bullied onboard and having the cook serve him leftovers. Let me tell you that things like this tend to happen. I've had observers who have lost 13 pounds at sea. So again, communication is the key.

Our observers are not fisheries observers they are scientific observers. Science begins with them. I tell you all to reconsider this designation. Here in Chile observers go by the name of scientific observers. Our high degree researchers often brag about their level of studies, they have University degrees, PhD's etc. and to them the observer is just someone doing all the dirty work. Well I tell you this: the observer is handing us that scientific reality we search for, therefore he is part of the science chain no matter how low his educational level is. We do not know of a school for scientific observers. It does not exist. That is why we sometime improvise observers, and because of this issue we pay low salaries or do not consider him as a person.

During our Data Quality Workshops we had observers present about the knowledge and skills needed to obtain quality data and also discussed pertinence. Belonging to an institution should benefit the observer-researcher interaction and provide an exchange of point of views. After all, it is the observer who is closest to the composition of discards, catch composition, total catch. We have to incorporate them to the system. No more faxes and emails, no more manuals and requirements, please talk and communicate with each other.

In my opinion, these are two issues that were absent in this IFOMC. Being part of the Steering Committee has enormously helped me to see the world of fisheries science and observers from another perspective, with more tranquility, with another vision. I remember saying that "The first link of fisheries science are the observers." I was wrong, it's the fishermen. They have the scientific knowledge; we give it a scientific context and transform it into the knowledge needed for a sustainable management of fisheries. Therefore, it is essential to develop an institutional and inter-institutional communications link. This is a wonderful instance; let's make full use of it. Let's not leave the human side apart.

I want to thank the Scientific Committee and especially Dennis, who has an incredible eye on small details but again very important ones. I would also like to thank Teresa Turk, now Teresa has more of a motherly approach but again is very concerned on those things we tend to forget or let pass by. I would also like to thank Lisa, Amy, Greg and the Steering Committee in general. All of you helped us put this together and guided us when help was needed, your feedback and knowledge is something really rewarding for me. During these 2 years we were able to establish a friendly conversation; same communication I say not always exists. I'd like to thank all the contributions made by our sponsors and supporters, the abstracts submitted by all of you and the constant communication we have had over this period. I have learned that communication is fundamental, and become more aware of its importance. I have undoubtedly grown as a human being.

With this we end this 7<sup>th</sup>IFOMC; we have lots of homework for the next conference, and keep in mind that we must prevail over the technological. I hope we can continue with these meetings in the future, all of you are wonderful people, working together in a high risk job for the benefit of mankind and marine life. Thank you very much.

## Overview of the 7<sup>th</sup> IFOMC according to Evaluation form

The evaluation form is a way to score the conference's overall outcome and help us plan better for future IFOMC's. We believe important to point out the following outputs:

A total of 41 evaluation forms and 10 online evaluations were registered. Both consisted of 10 items rating from 1 to 5, being 5 the highest.

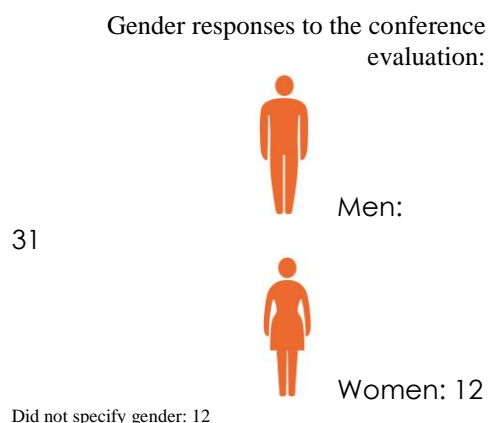
The highest percentage of approval (score of 5) was the "Social Events" item with a **58.5%** of acceptance, followed by **51.2%** on both "Range of topics and Quality of speakers". The overall conference evaluation received a **48.8%** approval with a score of 4. The Tools of the trade Exhibition and Venue facilities were the items with the lowest rank.

Below is a summary table that visualizes statistical information (%) of the evaluation process

ITEM	5	4	3	2	1	Null
Range of topics	51,2	36,6	12,2	0,0	0,0	0,0
Quality of speakers	51,2	39,0	9,8	0,0	0,0	0,0
Speaker facilities	43,9	36,6	19,5	0,0	0,0	0,0
Poster program	19,5	53,7	19,5	2,4	2,4	2,4
Trade exhibition	9,8	14,6	43,9	19,5	0,0	12,2
Social events	58,5	31,7	7,3	0,0	0,0	2,4
Catering	43,9	29,3	19,5	7,3	0,0	0,0
Venue facilities	29,3	31,7	24,4	7,3	2,4	4,9
Overall conference organisation	36,6	48,8	12,2	2,4	0,0	0,0
Value for money	24,4	39,0	19,5	4,9	2,4	9,8

The average score for each item is as follows:

Item	Average score
Range of topics	<b>4,4</b>
Quality of speakers	<b>4,4</b>
Speaker facilities	4,2
Poster program	3,8
Trade exhibition	2,8
Social events	<b>4,4</b>
Catering	4,1
Venue facilities	3,6
Overall conference organisation	4,2
Value for money	3,5



## Random responses from the evaluations from each question that appeared on the conference evaluation form

### 1. What did you enjoy most about the Conference?

- *“Interacting with observers / staff at nightly functions. The wine tasting & Café Journal were excellent!”*
- *“I really enjoyed meeting people from other programs and learning about observer programs around the world. It is comforting to hear we are all facing similar issues and can help each other when facing them.”*
- *“Coming to Chile and finding that it is a very nice and safe place as the multinational participation / Presence.”*
- *“Different perspectives and insights from observer programs all over the world.”*
- *“By far the range of people and their experiences was fantastic. The conference organizers did a great job of creating a good social atmosphere for the networking opportunities.”*

### 2. Did you participate in a Work Group? Breakout Session? Other?

- *“There were no breakout sessions that I noticed. The workshops seemed just like the panels”*
- *“The proposed oral presentations of posters was missing”*
- *“Workshops-really no difference from regular sessions. Would be nice to have a format more conducive to question & discussion. On that note, I think the question process in general was inefficient & could have been planned better”*
- *“No, I was hoping the workshop would be more hands-on or we could break into discussion groups but it was just like any presentation.”*
- *“Yes, was very beneficial and aided in the exchange of ideas”*
- *“No. I didn’t know there is anyone, perhaps because I’m new in the area”*

### 3. Did the conference adequately address the vision statement? *To develop, promote and enhance effective fishery monitoring programs to ensure sustainable resource management throughout the world's oceans.*

- YES: 48
- NO: 2

### 4. Did the conference adequately address the mission statement? *To improve fishery monitoring programs worldwide through sharing of practices and development of new methods of data collection and analysis. To provide a forum for dialog between those responsible for monitoring fisheries and those who rely upon the data they collect.*

- YES: 50
- NO: 0

- *“It would have been nice to have more participation from industry, especially captains that use observers. Perhaps even a session for them to express their opinions instead of having to rely on Q&A at end of sessions.”*
- *“The data collected helps different government and stakeholders to manage their living marine resources sustainably.”*
- *“It is very interesting and important to learn about observer programs around the globe”*

#### **5. Is there anything we could improve?**

- *“Have a template for introduction of talks, that “must” include:*
  - 1) Programme name*
  - 2) Location*
  - 3) Number of vessels*
  - 4) Gear types*
  - 5) Target species*
  - 6) Number of active observers in Programme.*

*This helps to better understand what was accomplished and helps to compare with other programmes.”*

- *“Poster could be standard for all countries.”*
- *“Multiple smaller workshops so more participants can contribute to discussions.”*
- *“More presentations directly related to fisheries observing and monitoring.”*
- *“Presentations should be recorded on film. This will allow those who were not present the chance to view them ”*

#### **6. Any other topics/program elements you would find valuable at future Conferences?**

- *“More hands on activities.”*
- *It is great to network with people at all levels of fisheries management. It is very refreshing to have some fun and artistic elements such as those offered by the Observe this! Video, and the observer (Derek Kudda) did fish print workshops.”*
- *Women in the workforce: Crew relations, harassment / discrimination, interpersonal benefits & challenges.”*
- *“Importance of observer retention. In my opinion this is the most important factor in producing more accurate data.”*
- *“Different workshop structure which is more workshop oriented and less panel like. Maybe a part about women observers and the challenges they face”*
- *“I think an open debate forum discussing the role of observers ranging from purely scientific to stand enforcing roles”*

**7. This conference is currently held biennially, should it be held more or less frequently? Judging by the difficulty of participants securing funding for this year, less frequent may enable more participants to attend.**

*The majority responded it should continue to be held biennially.*

**8. Other comments:**

- *“The conference was very impressive as one met different people with different experience in fisheries management.”*
- *“I would like to thank the panelists for sharing their knowledge and showing us their interest and love for what they do. It is very motivating.”*
- *“I had a wonderful time! It was nice to receive recognition and support as fisheries observer/monitor. The opportunity to have so much exposure and networking with such a variety of people in this field has been very rewarding and Chile has proved to be a world class destination with wonderful, friendly people!”*
- *“Consider holding next conference in winter / less busy season for observers”*
- *“This was my first conference. As an experienced observer ( 9 years so far), sometimes over the years I have felt discouraged, misunderstood and underappreciated in relation to the work I do. My experience at this conference was eye-opening. The support, enthusiasm and recognition I received from the world community was incredible, and has truly rejuvenated my drive to continue my observing career. I have always held myself to a very high standard as an observer & scientist but sometimes feel forgotten by the industry, and not given the credit and support we deserve. I would like to thank Oscar Guzman, the IFOP and the country of Chile for hosting a wonderful event. The enthusiasm and passion for observing displayed by the Latin American Community was amazing, and I think the rest of the world can learn a lot from this.”*
- *“I would have appreciated more of a clear connection drawn between the topics and Chile. It was not clear why we came here”*

## Countries present at the 7<sup>th</sup> IFOMC



Argentina



Australia



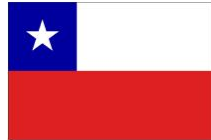
Belgium



Brazil



Canada



Chile



Costa Rica



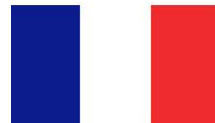
Denmark



Ecuador



Estonia



France



Ireland



Japan



Mexico



Micronesia



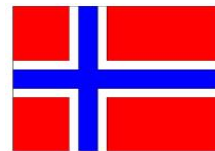
Namibia



Netherlands



New Zealand



Norway



Peru



Portugal



South Africa



South Korea



Spain



United States



United Kingdom



Venezuela

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# APPENDICES

## International Observer Bill Of Rights - A guide to the health, safety, welfare and professionalism of observers

The original Observer Bill of Rights (OBR) was published in 2000 as the product of a workshop and panel session held at the Canada - US Fisheries Observer Programme Workshop, St. John's, Newfoundland, Canada (Anon. 2001), which was the second conference in the International Fisheries Observer and Monitoring Conference (IFOMC) series. The original drafters included active and former observers who felt that the managing agencies and employers were in need of best-practice guidelines in order to enhance and maintain a professional corps of observers. The Observer Professionalism Working Group (OPWG) was initiated at the 5th IFOMC in 2007 (McVea and Kennelly 2007), using elements of the OBR for its workshops and resulting documents (Davis and Quelch 2008). The OBR was last modified in the 5th IFOMC proceedings (McVea and Kennelly 2007). The current version widens the scope of the document to the ever-increasing corps of observers worldwide. The IOBR has been developed to clearly delineate the employment and human rights of the observer. It is complemented by the provisions of the Code of Conduct for Responsible Observer Programmes - Observer Health and Safety (CCROP-HS) and Stakeholder Responsibilities (CCROP-SR). A standard list of definitions is used for referencing these documents (CCROP-SR, Glossary). The two supplemental CCROP documents detail what is required to implement the IOBR. These documents don't intend to supersede any existing international, regional, national, state/provincial or local law or observer programme requirements, which may be more extensive or restrictive. All observer rights are equal and shall not be construed to deny or disparage other rights retained by the observers.

This International Observer Bill of Rights (IOBR) was modified in collaboration with current and former members from the Association for Professional Observers (APO) and the OPWG, as well as input received in association with the 7th IFOMC<sup>1</sup> (150 delegates from 27 countries), held in Viña del Mar, Chile, April 8-12, 2013. These documents were distributed for public comment to over 1200 stakeholders internationally from February 2013 until August 2013. Venues for outreach were the APO Mail List, APO Facebook Group, the 7th IFOMC Steering Committee, and targeted mail lists of additional public stakeholders.

The APO has agreed to be the custodian of this document and associated CCROP-HS and CCROP-SR documents. These documents will be modified biennially with stakeholder input<sup>2</sup>. For enquiries, comments, contributions and updates, please contact the IOBR Team: E-mail: [iobr@apo-observers.org](mailto:iobr@apo-observers.org); Web: <http://www.apo-observers.org/billofrights>.

### Introduction

An 'observer' is a person who is authorised by a regulatory authority to collect information in the field (either at sea or on shore) to support sustainable aquatic resource management. The observer must be financially independent of the industry being monitored (CCROP-SR, Section V). Observers generally do not have enforcement powers but their duties often involve the collection of enforcement related information. There are many titles associated with the observer profession, some of which do not have the word "observer" in the title (such as monitor, fisheries assistant, inspector, and sampler). For the purposes of this document, the term "observer" is inclusive of several analogous positions under the monitoring, compliance and surveillance (MCS) umbrella (Flewwelling 1994, Flewwelling et al. 2002).

Observers are tasked with a wide range of duties that are primarily related to commercial fishing, although other industries impacting the ocean environment may be monitored as well. Observer programmes typically have a multitude of objectives ranging from science to compliance and frequently a combination of both (Davies and Reynolds 2002). Observers are typically either hired by third party contractual agreements or directly by a government regulatory authority. However, sometimes observers are hired as independent contractors. Regardless of employer, observers generally work independently and unsupervised in an isolated and sometimes contentious environment and a variety of entities may negatively impact their ability to complete their duties. The intent of these documents is to establish international standards that programmes can strive toward and to clarify and harmonise observer terms of reference. Standard terms of reference relating to professional levels of observers would make it easier for an observer to transfer their expertise and clarify the technological level of data collected in a programme for data end-users.

## **Article I - Employment Terms**

### **I. Observers have the right to a written contract that clearly defines employment terms (CCROP-SR, Section III (9), including:**

1. Position level as it relates to qualifications, competencies, responsibilities and types of data collected;
2. Hiring, promotion, probation, demotion and firing criteria;
3. Health, life, and disability insurance terms (IOBR Article III(3));
4. Wage linked with observer experience, performance, position, and location; segregated by different components of observer employment;
5. Employment leave terms (including holiday/vacation, bereavement, medical and employment re-entry terms);
6. Retirement package terms;
7. Protocols for deployment and field support of observers (e.g. travel logistics and documents, cash, gear, food, accommodations and medical needs), in the field and during briefings, trainings, debriefings, and during standby intervals;
8. Specify payment interval frequency and disclose any payroll deduction types (e.g. expenses, cash advances, and taxes);
9. Observer gear and equipment requirements and maintenance;
10. Protocols that ensure safe and healthy working conditions (CCROP-HS Section IV);
11. Communications and Emergency action plan: protocols for helping and/or rescuing observers from emergency situations, including interference, harassment or assault scenarios (CCROP-HS Section IV(7));
12. Performance evaluation criteria and frequency;
13. Employer's Plan of Action for observer's professional development;
14. Professional stakeholder *Codes of Conduct* (CCROP-SR).

## **Article II - Fair and Equitable Employment**

### **II. Observers have a right to non-discriminatory, fair and equitable employment, including:**

1. Work environment free of discrimination based on factors such as gender, ethnicity, race, spiritual beliefs, age, class, sexual orientation, nationality or political activities;
2. Equal opportunity grievance procedure available at no cost to the observer. Grievance procedures must be independent of observer programme and observer employer influence and include an appeal process. Employers and observer programmes must specify the equal opportunity grievance procedures as part of a labour agreement and must comply with national labour law;
3. Transparent and unbiased protocols used to select individual observers for a given deployment;
4. Performance evaluations that are transparent to the observer, part of the debriefing process and include criteria used by both the observer programme and employer. Observer programmes and employers shall afford a system of warnings within their performance evaluations that allow the observer the option of appealing the evaluation or make the necessary changes to return to good standing with the programme and the employer;
5. Fair labour standards for observers at both the observer programme and observer employer level. Reviews of programme and observer employer adherence to fair labour standards must be regularly performed, be transparent, independent and easily accessible to new and former observers;
6. No employer may, without cause, fire, demote or restrict an observer from employment opportunities. The employer shall clearly support any termination of an observer's employment with both observer programme and observer employer policies and documentation, stated in the observers' employment contract and in accordance with national labour laws.

### **Article III - Competitive Wage Package**

**III. Observers have a right to a competitive wage package commensurate with positions requiring similar duties and educational background (IOBR Article I; CCROP-SR Section III (9, 10, 11 and 14)). Financial independence from the monitored industry is crucial. A competitive wage package includes but is not limited to:**

1. Step-based pay system that acknowledges different observer levels (defined by variations in duties, responsibilities) and encourages experience and work performance that meets or exceeds expectations;
2. Transferability of observer credit (experience) for purposes of financial compensation from one programme to the next, regardless of employer;
3. Insurance coverage, with consideration for coverage being equivalent to observer field (sea) time, and consideration of a national or group pool to decrease cost, including:
  - i. Basic health coverage provided for employment period;
  - ii. Options for year round (comprehensive, beyond employment/during stand-by periods) health coverage;
  - iii. Life insurance, which provides compensation to a named beneficiary in case of death;
  - iv. Disability insurance; for long-term, cumulative injury arising from work related injuries that were not originally detected during the work such as back problems, knee failure, lung problems;
4. Retirement package options;
5. Shore-based work alternatives for older observers and those who experience disabilities resulting from their observer careers;
6. Leave remuneration including compensation options that acknowledge leave-time needs (e.g. vacations and holidays) between deployments;
7. Payment for all time awaiting deployment, between deployments or waiting to be debriefed.

### **Article IV – Health and Safety**

**IV. Observers have a right to a working environment with minimal health and safety risks (See CCROP-HS), including:**

1. Ability to conduct duties free from assault, harassment, interference or bribery (CCROP-HS Section III(2)(A)(xii) and (E)(iii) and Section IV(1); CCROP-SR Section I(2 and 3), Section II(1)(E), (3)(B), (14, 17 and 20), Section III(3)(A and B), (13, 14, 16 and 17), Section IV, Section V(10 and 11));
2. Right to refuse an assignment without negative repercussions, with documentation of reason. Observer programmes or employers shall not require observers to address any vessel inadequacies that cause vessel refusal (CCROP-SR Section III(13) and Section IV (7, 8); CCROP-HS Section IV);
3. National/international protocol developed for checking minimum compulsory safety and emergency-action equipment prior to each deployment (e.g. pre-deployment checklist, CCROP-HS, Box 2). Protocol must also include documentation of vessel refusal, follow-up actions taken by appropriate regulatory authority and observer employer (if different) to address any safety or accommodation issues and how any shortfalls were resolved prior to placement of subsequent observer;
4. Development and enforcement of laws protecting observer health and welfare;
5. Established minimum standards for adequate accommodation for an observer deployment appropriate to the size of the monitored entity and equivalent to that of the officers of the monitored entity (CCROP-HS Section IV (4); CCROP-SR Section 1(3), Section II (3)(B), Section III (13 and 17) IV(13, 14 and 17));
6. Transparency (especially available to observers) of safety and welfare reports from previous observer deployments (especially on refused assignments). Include accountability report, with follow-up and actions taken to rectify problem;
7. Minimum health and safety training standards, safety protocols and that are programme-specific. (CCROP-HS Section III and IV);
8. Communication protocols and emergency action plan (CCROP-HS Section IV (5 and 7)).

### **Article V - Regulatory Authority, Observer Programme and Observer Employer Support**

#### **V. Observers have the right to regulatory authority, observer programme, observer employer and monitored entity support, including:**

1. Regular communication between observer programme/employers and the observer while they are deployed (CCROP-HS Section IV(7); CCROP-SR Section II(1)(B) and Section IV(11));
2. Assessment and attendance to observers' health and welfare status, including mental health (CCROP-HS Section I(2) and Section IV(8); CCROP-SR Section II(14 and 17), Section III(14,16 and 17), and Section IV);
3. Face-to-face debriefings (CCROP-SR Section II(17));
4. Adequate break time between deployments (CCROP-HS Section I(2)(C) and Section IV(6 and 8); CCROP-SR Section III(14));
5. Debriefings and performance evaluations by observer programme personnel who are experienced in data collection from the resource they are monitoring (CCROP-SR Section II(14)).

### **Article VI - Stakeholder Integrity, Responsibility and Programme Transparency**

#### **VI. Observers have a right to stakeholder integrity and programme transparency (See CCROP-SR), including but not limited to:**

1. Financial independence of observer, observer employer and observer programme from monitored entity is crucial (CCROP-SR Section I(1), Section, II(3)(A), Section III(4), Section IV(15) and (16)(B) and Section V(3, 10 and 11));
2. Institutionalised whistle-blower rights for observers with a third party for observers to address both employer and observer programme issues;
3. Minimum data collection and debriefing standards that ensure the objectives of the programme are met and accounted at a prescribed level of quality;
4. Enforceable *Codes of Conduct* for stakeholders that support the integrity of all levels of the observer programme (CCROP-SR Section I(1));
5. Transparency of observer programme statistics that allow comparison of programme, including retention rates and actual deployment/employment rates.

### **Article VII - Professional Development**

#### **VII. Observers have a right to professional development, including but not limited to:**

1. Acknowledgment of individual observers for their contribution to science and resource management through credit in publications and support of their attendance at observer programme conferences and workshops;
2. Inclusion of observers and observers' perspective in observer programme decision-making processes that impact the observer's work environment (CCROP-SR Section I(1), II(1)(C), (6, 17));
3. Connection with data users through workshops, presentations and programme libraries of reports based on data collected by observers and make these easily available to observers (CCROP-SR II(19));
4. Certificate or training endorsements that documents additional training and use of special sampling equipment, skill level obtained and information about the project (CCROP-SR Section II(18), Section III (3)(D), (5 and 15)).

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<http://www.ifomc.com>

<sup>2</sup> The next revision will begin by September 2015.

## Commonly Used Abbreviations

**AA** - Aves Argentinas  
**ABARE** - Australian Bureau of Agricultural and Resource Economics  
**ACL** - Annual Catch Limit  
**ACP** - African, Caribbean and Pacific Group of States  
**ADFG** - Alaska Department of Fish & Game  
**AFA** - *American Fisheries Act*  
**AFMA** - Australian Fisheries Management Authority  
**AFSC** - Alaska Fisheries Science Center  
**AHP** - Analytic Hierarchy Process  
**AIC** - Akaike Information Criteria  
**AIDCP** - Agreement on the International Dolphin Conservation Program  
**AMR** - Archipelago Marine Research Ltd.  
**AMSEA** - Alaska Marine Safety Education Association  
**APO** - Association for Professional Observers  
**ASHOP** - At-Sea Hake Observer Program  
**ASOP** - American Samoa Observer Program  
**ASOP** - At-sea observer program  
**BC** - British Columbia  
**BRTs** - By-catch Reduction Technologies  
**BSAI** - Bering Sea / Aleutian Islands  
**CCAMLR** - Commission for the Conservation of Antarctic Marine Living Resources  
**CCCHFA** - Cape Cod Commercial Hook Fishermen's Association  
**CCSBT** - Commission for the Conservation of Southern Bluefin Tuna  
**CECAF** - Committee for the Eastern Central Atlantic  
**CENDEPESCA** - Centro de Desarrollo de la Pesca y la Acuicultura (El Salvador)  
**CFP** - Common Fisheries Policy  
**CFVS** - Commercial Fishing Vessel Safety  
**CI** - Confidence Interval  
**CIDA** - Canadian International Development Agency  
**CoML** - Census of Marine Life  
**CPUE** - Catch Per Unit Effort  
**CSIRO** - Commonwealth Scientific & Industrial Research Organisation (Australia)  
**CSP** - Conservation Services Programme  
**CV** - Coefficient of Variation  
**DAS** - Days-at-Sea  
**DCR** - Data Collection Regulation  
**DFO** - (Department of) Fisheries & Oceans Canada  
**DINARA** - Área de Recursos Pelágicos of the Dirección Nacional de Recursos Acuáticos (Uruguay)  
**DMS** - Data Management Systems  
**DoFi** - Department of Fisheries (Vietnam)  
**DWLLF** - Distant water long-line fleet  
**EA** - Ecosystems Approach  
**EA** - Environmental Assessment  
**EAF** - Ecosystem Approach in Fishing  
**EBM** - Ecosystem-based management  
**EEZ** - Exclusive Economic Zone  
**EIS** - Environmental Impact Statement  
**ELB** - Electronic Logbook  
**E-Logs** - Electronic Fishing Logbooks  
**EM** - Electronic Monitoring  
**EMS** - Electronic Monitoring System

**ENGO** - Environmental Non-Governmental Organisation  
**EPIRBs** - Emergency Position Indicating Radio Beacon  
**EPO** - Eastern Pacific Ocean  
**EU** - European Union  
**EVTR** - Electronic Vessel Trip Report  
**FAD** - Fishery Attraction (Aggregating) Device  
**FAO** - Food and Agriculture Organisation  
**FERF** - Fishery Enhancement and Research Foundation  
**FFA** - Forum Fisheries Agency  
**FFDA's** - Fish Farmer's Development Agencies  
**FIMP** - Fisheries Information Management Program  
**FIT** - Fisheries Interaction Team  
**FLDRS** - Fisheries Logbook Data Recording Software  
**FMA** - Fisheries Monitoring and Analysis (AFSC)  
**FMP** - Fisheries Management Plan  
**FOS** - Fisheries Operating System  
**FoS** - Friend of the Sea  
**FPN** - Fundación Patagonia Natural  
**FRS** - Fisheries Research Services  
**Ft** - Feet  
**FVSA** - Fundación Vida Silvestre Argentina  
**GCEL** - NOAA Office of General Counsel for Law Enforcement  
**GCMD** - Global Change Master Directory  
**GDP** - Gross Domestic Product  
**GIS** - Geographic Information System  
**GloBAL** - Global By-catch Assessment of Long-lived Species  
**GPS** - Global Positioning System  
**H&G** - head and gut  
**HCE** - Humboldt Current Ecosystem  
**HTB** - High-opening trawl  
**IATTC** - Inter-American Tropical Tuna Commission  
**ICCAT** - International Commission for the Conservation of Atlantic Tuna  
**ICES** - International Council for the Exploration of the Sea  
**ICZM** - Integrated Coastal Zone Management  
**IDCP** - International Dolphin Conservation Program  
**IEZ** - Inshore Exclusive Zone  
**IFMP** - Integrated Fishery Management Plans  
**IFOMC** - International Fisheries Observer & Monitoring Conference  
**IFQ** - Individual Fishing Quota  
**IMARES** - Institute for Marine Resources & Ecosystem Studies (The Netherlands)  
**IMARPE** - Instituto del Mar del Perú  
**INP** - National Fisheries Institute of Ecuador  
**IOTC** - Indian Ocean Tuna Commission  
**iREC** - Internet Recreational Effort and Catch Survey  
**IPHC** - International Pacific Halibut Commission  
**IREPA** - Istituto Ricerche Economiche per la Pesca e l'Acquacoltura (Italy)  
**ITBP** - Innovative Technology and Business Process Program (DFO)  
**ITQ** - Individual Transferable Quota  
**IUCN** - International Union for Conservation of Nature & Natural Resources  
**IUU** - Illegal, Unreported and Unregulated  
**IVR** - Interactive Voice Response  
**IW** - Integrated weight longlines  
**IWPS** - Integrated weight longlines with paired streamer lines  
**Kg** - Kilogram  
**LMRs** - Living Marine Resources



**LOOP** - Logbook-Onboard Observers Program  
**MCS** - Monitoring, Compliance and Surveillance  
**MPI** - Ministry for Primary Industries (NZ)  
**MFMR** - Ministry of Fisheries & Marine Resources (Namibia)  
**MMPA** - *Marine Mammal Protection Act (U.S.)*  
**MOU** - Memorandum of Understanding  
**MPAs** - Marine Protected Areas  
**MSA** - *Magnuson Stevens Act*  
**MSC** - Marine Stewardship Council  
**MSFCMA** - *Magnuson-Stevens Fishery Conservation and Management Act*  
**Mt** - Metric ton  
**M** - Meter  
**MUN** - Memorial University  
**NAFO RA** - Northwest Atlantic Fisheries Organisation Regulatory Area  
**NBR** - National Bycatch Report  
**NEFOP** - Northeast Fisheries Observer Program (NMFS)  
**NEFSC** - Northeast Fisheries Science Center (NMFS)  
**NEPA** - *National Environmental Policy Act*  
**NERO** - Northeast Fisheries Regional Office  
**NGOs** - Non-government organisation  
**NIWA** - National Institute for Water and Atmospheric Research (New Zealand)  
**NLMA** - Nantucket Lightship Management Area  
**NMFS** - National Marine Fisheries Service, also NOAA Fisheries Service  
**NOAA** - National Ocean and Atmospheric Administration (USA)  
**NOP** - National Observer Program (NMFS)  
**NOPAT** - National Observer Program Advisory Team  
**NPFMC** - North Pacific Fisheries Management Council  
**NPGOP** - North Pacific Groundfish Observer Program  
**NSW** - New South Wales  
**NWFSC** - Northwest Fisheries Science Center  
**NZ** - New Zealand  
**NZ RLIC** - New Zealand Rock Lobster Industry Council  
**NZFIB** - New Zealand Fishing Industry Board  
**OBIS** - Ocean Biogeographic Information System  
**OBR** - *Observer Bill of Rights*  
**OBSCON** - Observer Contract database  
**OC** - Scientific observer  
**ODA** - Official Development Assistance  
**ODS** - Operational Data Store  
**OFCF** - Overseas Fishery Cooperation Foundation  
**OLE** - NOAA Office of Law Enforcement  
**OP** - Observer program  
**OPWG** - Observer Professionalism Working Group  
**OTBS** - Bottom trawl  
**OTIS** - Observer Trip Information System  
**OTL** - Ocean Trap and Line (NSW)  
**OY** - Optimum yield  
**PA** - Precautionary Approach PBR Potential biological removal  
**PBS** - Pacific Biological Station (Nanaimo, BC)  
**PCR** - Polymerase chain reaction  
**PDA** - Personal Digital Assistant  
**pdf** - probability density functions  
**PFD** - Personal Flotation Device  
**PIFSC** - Pacific Islands Fisheries Science Center  
**PIRO** - Pacific Islands Regional Office

**PIROP** - Pacific Islands Regional Observer Program  
**PNOFA** - Programa Nacional de Observadores a Bordo de la Flota Atunera Uruguaya  
**PO** - Programa de Observadores / Observer Program  
**POBCH** - Chubut Province Onboard Observer Program  
**POP** - Pelagic Observer Program  
**POPA** - Azores Fisheries Observer Program  
**PSC** - Prohibited Species Catch  
**PTB** - Paired bottom trawl  
**QAC** - Quality Assurance & Control  
**QMS** - Quota Management System  
**RCMP** - Royal Canadian Mounted Police  
**RFMOs** - Regional Fisheries Management Organisations  
**RFOs** - Regional Fisheries Organisations  
**RIMF** - Research Institute for Marine Fisheries (Vietnam)  
**RONS** - Regional OBIS Nodes  
**ROP** - Regional Observer Program  
**SAPs** - Special Access Programs  
**SARA** - Species at Risk Act  
**SBT** - Southern Bluefin Tuna  
**SCL** - Steering Committee Liaison  
**SEAFDEC** - Southeast Asian Fisheries Development Centre  
**SEDAR** - Southeast Data Assessment and Review stock assessment number ten  
**SEFSC** - Southeast Fisheries Science Center  
**SET** - South-east trawl  
**SG** - Sea Grant  
**SP** - Service Providers  
**SPC** - Secretariat of the Pacific Community  
**STB** - Single bottom trawl  
**T** - tonnes  
**TAC** - Total Allowable Catch  
**TD** - temperature-depth  
**TEDs** - Trawl efficiency devices OR Turtle Excluder Devices  
**TFP** - Total Fish Production  
**TRN** - Net Register Tonnage  
**TTS** - Text to Speech  
**US** - United States  
**USA** - United States of America  
**UIW** - United Industrial Workers (Alaska Fisheries Division)  
**UK** - United Kingdom  
**UN** - United Nations  
**UNCED** - United Nations Conference on Environment and Development  
**UNIPESCA** - Unión Nacional de Pescadores Conservacionista (Guatemala)  
**UNIVALI** - University Universidade do Vale do Itajaf  
**USB** - Universal Serial Bus cable  
**USCG** - United States Coast Guard  
**UW** - Unweighted longlines  
**UWPS** - Unweighted longlines with paired streamer lines  
**WCPFC** - Western Central Pacific Fisheries Commission

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