IFOMC

10th International Fisheries Observer and Monitoring Conference

Hobart | Tasmania | Australia | 6 - 10 March 2023

Proceedings of the 10th International Fisheries Observer and Monitoring Conference

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The 10th IFOMC International Steering Committee

ISBN: 978-0-6488217-1-7

Preferred citation:

Kennelly, S.J. (ed.) (2023). Proceedings of the 10th International Fisheries Observer and Monitoring Conference, Hobart, Tasmania, Australia. ISBN: 978-0-6488217-1-7, 351 pages.

Preferred citation of a paper within these Proceedings:

Lopes dos Santos, M., Begoña Santos, M. Carocci, F. and C. Morgado (2023). Evaluating compliance in fisheries. Pages 13-16 in Kennelly, S.J. (ed.) Proceedings of the 10th International Fisheries Observer and Monitoring Conference, Hobart, Tasmania, Australia. ISBN: 978-0-6488217-1-7.

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Acknowledgements

We would like to express our deepest appreciation to all those who participated in and supported the 10th International Fisheries Observer and Monitoring Conference. In particular we acknowledge the Conference Organising Committee, whose contributions over many months led to a very successful conference that resulted in tangible outcomes for the well-being of observers and the ongoing monitoring of fisheries throughout the world.

We thank especially our hosts, the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) who supplied all kinds of assistance and staff before, during and after the event. We also thank the Tasmanian government for their invaluable support in providing venues for the conference.

Our conference PLATINUM sponsors NOAA Fisheries and CCAMLR deserve special mention for assisting the event financially and providing a great deal of display material and other support. Our SILVER sponsors Anchor Lab and the Fisheries Research and Development Corporation (FRDC) also contributed significant funding for the event. And our BRONZE sponsor the Environmental Defense Fund also assisted financially.

In addition, our exhibitors, Archipelago Marine Research, Ai.Fish, Anchor Lab, the Australian Fisheries Management Authority, AIS, Integrated Monitoring, OLSPS and Satlink not only assisted the conference financially but provided an array of fantastic technical backdrops to the event with many varied and cutting edge displays of their latest equipment, software and other materials.

We also would like to acknowledge our volunteer rapporteurs who took detailed notes of all the many lengthy discussion sessions during the conference. These were: Phil Bear, Cheng Shi, Colleen Rodenbush, Shane White, Lewis Koplin, Jared Sanchez, Zane Duncan, Carolina Breakell, Staci King, James Grunden, Rachel Mahler and Rachel Howland.

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

Sponsors

PLATINUM

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Exhibitors

The 10th IFOMC International Steering Committee

The Steering Committee for the Conference was fundamental to the success of the event, organising many aspects of the meeting as well as individually taking charge of the 12 themes and 4 workshops that ran throughout the meeting. The Steering Committee members were:

- Isaac Forster (Committee Chair), CCAMLR, Australia
- Lisa Borges, FishFix, Portugal
- Luis Cocas, Undersecretariat for Fisheries an Aquaculture, Chile
- Jørgen Dalskov, DTU Aqua, Denmark
- Jennifer Ferdinand, NOAA/NMFS, USA
- Lesley Hawn, NOAA/NMFS, USA
- Kenneth Keene, NOAA/NMFS, USA
- Steve Kennelly, IC Independent Consulting and Archipelago Asia Pacific, Australia
- John LaFargue, NOAA/NMFS, USA
- Amy Martins, NOAA/NMFS, USA
- Mark Michelin, CEA Consulting, USA

And those who couldn't make the actual conference:

- Elizabeth Scott-Denton, NOAA/NMFS, USA
- Justin Clement, Ministry for Primary Industries, New Zealand
- Greg Hammann, Marine Instruments, Spain
- Corey Webster, Fisheries and Oceans, Canada

Executive Summary

The 10th International Fisheries Observer & Monitoring Conference took place at the Hobart Function Centre, Tasmania, Australia from 6th to 10th March, 2023.

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

The conference was very successful involving 233 participants from 30 countries including representatives from many observer programs, fisheries managers, fisheries scientists, fishing industry groups, and end-users of the data that these programs collect. The conference format included one distinguished keynote speaker, presented papers and posters, panel discussion sessions, workshops and less formal settings, such as trade exhibits, poster sessions and social events.

As for previous conferences, the heart of this conference was the Fisheries Observers who perform what is accepted as one of the most challenging and dangerous jobs in natural resource management. Indeed, this conference series always devotes significant time and energy discussing ways to enhance Observer safety, well-being and security through training, support, policing and legislation.

In addition, as for recent conferences, this meeting also had a significant focus on the growing role that technology is playing in the monitoring of fisheries, through communications, video, satellite and other high-tech means.

The conference consisted of 12 themes that were reflected in the keynote address, oral and poster presentations, workshops and the many Open Discussion periods. The following pages provide significant detail about all these various formats in the form of summaries of each presentation, the 4 workshops and commentaries obtained during the Open Discussion periods.

Opening Session

The opening session of the 10th IFOMC began with the Conference Chair, Isaac Forster, welcoming participants to Hobart, Tasmania, Australia and introducing the themes and format of the conference.

This welcome was followed by a Statement to Country delivered by Janice Ross, Saltwater Sister and Pakana Tasmanian Aboriginal Community member. Next was the Conference Keynote Address by Dr David Agnew, Executive Secretary of CCAMLR. The following is the Statement by Janice and an Extended Abstract of David's presentation.

Statement to Country

I acknowledge with heart.
The stars, the sky, and the milky way
that has guided our people since time began,
The salt waters, fresh waters, and earth country,
and all life's journey's in-between

My name is Janice I am a saltwater sister, my people are *pakana* and my Ancestors the *truwulway* people from Cape Portland, Northeast of *lutruwita* Tasmania.
We are known as the moon bird people of the Bass Strait Islands.

I speak with the spirit of our Old People, those who came before us. It is through their strength and resilience that our culture and connections continue to live on.

I talk more about knowledges, learning more, and the heart of *lutruwita*. All the complex systems that make up Country.

Currently *pakana palawa* Tasmanian Aboriginal People are working together persisting in the return of our water rights and input of our Knowledge systems that have continued through families especially in *tayritja-ti* - The Bass Strait Islands.

Our Ancestors, Elders and Community for thousands and thousands of years, continue to hold significant cultural responsibilities to care for our Sea Country. Not twenty odd years or so, we have been sustainably using and managing our Sea Country for thousands of years.

Where are our people now within this International Fishing agenda that would no doubt challenge but create constructive understandings in how we can work together in helping to protect sea country and the salt waters of *tayritja,* the Bass Strait Islands, from threats and pressures, to minimise damage, and to rehabilitate and improve the resilience of sea country.
Every year I travel to the Northwest of my country *premingana* Aboriginal managed and maintained land to practise my culture with my family and with my people. We gather the

kelp washed in from the waters to pass on knowledges to our younger generations and talk about how our people walked with this country long time, deep time, in synchronisation, in a reciprocal relationship with our country.

I could not imagine visiting my sea country in years to come and not find any marina shells from our sea grass beds, not finding any kelp to create our water carriers, and when I head to our islands in *tayritja-ti* the Bass Straits only to find that our birds who have returned from their long migration paths have consumed plastic in their tiny stomachs, no birding due to the depleted numbers would be far from comprehendible.

All this industrialisation is impacting on what WAS our healthy sea systems, impacting on our sea life, our Krill, our birds, and our whale's existence.

It is impacting everything around our little island home *lutruwita*.

Industrialising our saltwater country for economic gain.
There is significance of the salt waters to our people, our fish traps and handmade baskets in synchronisation with the tides, weather patterns and seasons, the significance of our continued cultural practises of shell necklace making, kelp water carriers, muttonbirding and our song-lines that travel with all First Nations People, are at increased threat from the invasion to our waters.

All those working within the International Fisheries observance and monitoring systems need to become invested in our ancient waterway knowledges with our knowledge holders, with our Elders and with our people and contributing towards a collaboration, invitation and consulting with our sovereign owners of this island *lutruwita* to the caring for sea country, the caring through eco-logical lenses.

Where is TALSC our Tasmanian Aboriginal Land and Sea Council?
Where are our Aboriginal Land Management and Heritage workers?
Why are our people being excluded?

We have already had an invasion of our lands, and when country became colonised, our women sealers were stolen, our lands stolen and now we are experiencing another invasion of our waters, where our waterways are now are being raped and stolen again.

There is imminent threat to our species that support our sea life and the eco-systems. That impacts not only my children, but all children, future grandchildren, and great grandchildren.

Many of you may be feeling a little squeamish at the moment, or feel the hairs on the back of your neck starting to stand up, but that's ok, it's ok to not feel in your comfort zone right now.

As this is a Statement not a Welcoming!!
But, a voice from our salt waters in a Statement from the heart. It's about Treaty and truth telling.

Our mutton birds migrate with the guidance of their little pilot bird in huge numbers following a path of eighty thousand kilometres or more from the Bass Straits through the Pacific oceans to Canada and Alaska every year.

Also, our whale song-line travels through *timtumili minanya* our waters of the Derwent River here.

The whale migrates along the East Coast of Victoria through *tayritja* the Bass Straits along the east coast and then through to the Southern Ocean of *lutruwita*.

Both magnificent and significant animals rely on a diet of krill, but large trawlers are taking tons of krill from our seas.

WHY?
It is not just happening to our water ways, but to our land also - that is becoming threatened, our people are too, and we are all one together.

The waters are warming, and the impact of these threats are killing our giant sea kelp, 90% of our kelp forests on the East Coast are in the process of rapidly dying.

Icebergs are melting and the seas are rising higher, we acknowledge our Pacific First Nations people who have already lost their Islands and we will be fighting to save our Islands too.

The long spine Sea urchins that travel on the eastern current are also eating our kelp forests, our crayfish that would eat the invading sea urchins saving our kelp, are now getting fished right out of our waters for profit.

I Acknowledge all First Nations people present,
And our country *nipaluna*, Country of Hobart, *lutruwita* Tasmania. Aboriginal Land,
We acknowledge with deep deep respect our Old People,
Our Traditional Owners the *muwinina mummurimina* people who did not survive British Colonisation but once walked the old tracks through this Country, together with the fresh waters from the mountain *kunanyi* traveling to meet the salt waters of *timtumili minanya*.
I acknowledge our pakana/palawa Tasmanian Aboriginal Elders and Community, past and present.

I acknowledge all Country, Land and Sea life and hope for a restorative healing future.

Aboriginal knowledges, understanding our story has always been important to us and Indigenous Peoples right around the globe.
As a way of transmission for important laws, and lore of remembering our beginnings as peoples and the birth of our respective countries, of kinship, of laws, of relationships, the seasons, and song lines.
We are Country and Country is us.
Whale traveling through our waterways…. we will hear your songs.

Janice deeply appreciates and acknowledges the significant knowledges shared by Fiona Maher, *pakana* Tasmanian Aboriginal Women's Sea Ranger on *truwuna-ta* Cape Barren Island, *tayaritja* in the Bass Straits.

Janice Maynard Ross 6.3.2023

Keynote Address

The crucial role of observers in CCAMLR fisheries and environmental management

David Agnew and Isaac Forster

Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR)

The CCAMLR Convention Area is approximately 36 million km2 in size covering 10% of the world's ocean area. The Convention is recognized by twenty-seven full member countries and a further 10 acceding states, with more than 20 additional intergovernmental or non-governmental organisations contributing to the operations of the convention through observer status and expert input.

The Convention was negotiated between 1978 and 1980, and came into force in 1982. The motivations for the drafting of the convention were mainly due to concerns with the overexploitation of krill stocks, and the effects that this may have on dependent Antarctic ecosystems. However, overexploitation of Antarctic Marine Living Organisms was not a new concept, historically seals and whales were hunted to near extinction around the Antarctic, and prior to the signing of the Convention a number of fish stocks were depleted after very large catches were taken around the South Georgia and Kerguelen island archipelagos.

A key objective of the Convention is to maintain ecological relationships between harvested, dependent and related populations of marine living resources in Antarctica. Currently two main fisheries operate in the Antarctic, one for Patagonian and Antarctic Toothfish which is low by volume, but very valuable per kg as it is a highly sort after table fish, with a firm white flesh, and one for Antarctic Krill, which is a high-volume fishery capped at 620,000 tonnes per annum, and is mainly used for producing aquaculture feedstock and nutraceuticals.

For all CCAMLR fisheries scientific observers on fishing vessels play a crucial role in both providing information that is used to assess stocks of commercially exploited species, and data on the impacts of fishing operations on other species that are encountered. First established in 1994, the CCAMLR Scheme of International Scientific Observation (SISO) deploys observers on all fishing vessels that operate in the CCAMLR area. Initially beginning with a low level of observer coverage in selected fisheries, the requirement for 100% observer coverage on all fishing vessels came into force in 2021, although in practice 100% coverage was required for most fisheries since the late 2000s. SISO observers are tasked with the collection of biological and sampling information of catch and bycatch species, providing data on the incidental mortality of seabirds and marine mammals, the collection of evidence of illegal, unreported or unregulated fishing activities, supervision of fish tagging programmes and monitoring of vessel operations. Data provided by observers plays a critical role in fish stock assessments and risk assessments for vulnerable species, and provides the bulk of information discussed in CCAMLR's Scientific Committee and Working Group meetings.

Data collected by SISO observers also underpins much of the research taking place in Marine Protected Areas in CCAMLR through identification of vulnerable marine habitats, and targeted sampling and tracking programmes that provide detailed information for specific areas. The programme also provides a long-term benefits such as the training of early career scientist, capacity building for member delegations as many observers are used to provide expert advice at CCAMLR's Scientific Committee's Working Groups, and connections and cooperation with industry specialists.

In summary many of the environmental management successes that CCAMLR is recognised for such as the virtual elimination of albatross and petrel bycatch, and the establishment of areas protecting sensitive marine habitats would not have been possible without the SISO programme. In future SISO observers will continue to form the backbone of CCAMLR fisheries and environmental management.

Session 1. Why monitor fisheries and what to monitor?

Leader: Steve Kennelly

This session explored some of the underlying reasons and requirements for monitoring fisheries. Through a series of case studies from around the world, it examined some of the key issues that have led society, fishing industries, governments, NGOs, ecolabels, etc. to require fisheries to be monitored. It examined the various types of information needed from monitoring programs - for scientific, compliance, enforcement and management purposes, to monitor bycatches of general discards and charismatic species, to monitor pollution like marine litter, for eco-certification purposes and to detect ecological patterns. By sharing information about the lessons learned, and fostering increased collaboration among the world's observer community, this session introduced elements that permeated throughout the rest of the conference.

Oral Presentations - Extended Abstracts

Evaluating compliance in fisheries

Mario Lopes dos Santos, M. Begoña Santos, Fabio Carocci, Cristina Morgado

European Fisheries Control Agency (EFCA)

Introduction

The European Fisheries Control Agency (EFCA) is one of the Agencies of the European Union (EU) established to coordinate fisheries control and inspection activities by the EU Member States and to assist them to cooperate, in order to ensure the effective and uniform application of the EU Common Fisheries Policy. EFCA promotes common standards for control, inspection and surveillance under the EU Common Fisheries Policy.

One of the key elements of the EU Common Fishery Policy, was a four year's phased implementation of the Landing Obligation (LO) starting in 2015, where all catches of species subject to catch limits or minimum sizes needs to be landed and counts against the respective quota. The ultimate aim of this regulation, which has been fully in force since January 2019, is to minimize discarding by encouraging more selective fishing and to avoid unwanted catches.

The implementation of the LO has been difficult, and flexibility was introduced (i) to reduce the economic impact on those fisheries where unwanted catches are very difficult to avoid and/or lead to disproportionate costs, designated as de minimis exemptions and (ii) for catches of species that have a high survivability rate, designated as high survivability exemptions.

Even with this introduced flexibility in the form of exemptions (i.e., for de minimis or high survivability), there has been concerns about a general lack of compliance with the LO compounded by weak enforcement (EC, 2019).

Compliance with fisheries legislation is dependent on many factors of very diverse nature, from the deterrence of the sanctions policy, the perceived legitimacy of all parties involved and in particular of the industry, the management measures in place, the practicality of its implementation and also on the control strategy and effort. To assess the appropriate control strategy and the adequate control effort is important to understand the role of these drivers and to determine the level of compliance.

EFCA has been assisting the EU Member States Control Expert Groups in several European Sea Basins to evaluate compliance with the Landing Obligation in their main fisheries. The information of the compliance level is a crucial step to improve compliance –to achieve compliance, we need to know where we are, and set our path towards where we want to go. This presentation summarises the methods used, and the results obtained, also providing some recommendations regarding control strategies to improve compliance.

Methodology

EFCA in collaboration with the EU Member States, established a dedicated inspection program, the "Last Haul" (LH), where during a sea inspection the catch composition of a haul is verified, and the catch quantities of the species subject to the LO are recorded as above and below the minimum conservation reference size. These data are submitted by MS to EFCA, which pools together the data and carries out the analysis by species, area and segments of the fleet.

By comparing (i) the quantities of catches below minimum conservation reference size, in relation to total catch, obtained from the LH inspections and (ii) the quantities reported in the logbooks, EFCA obtains an indicator of the discards by species (see Figure 1). The difference between LH and logbooks could result from illegal discarding and/or non-reporting of legal discards. To evaluate compliance, EFCA considers both cases as non-compliance with the provision of the LO and, by comparing these differences with agreed thresholds, it determines how compliance with the LO is evolving over time and across sea basins.

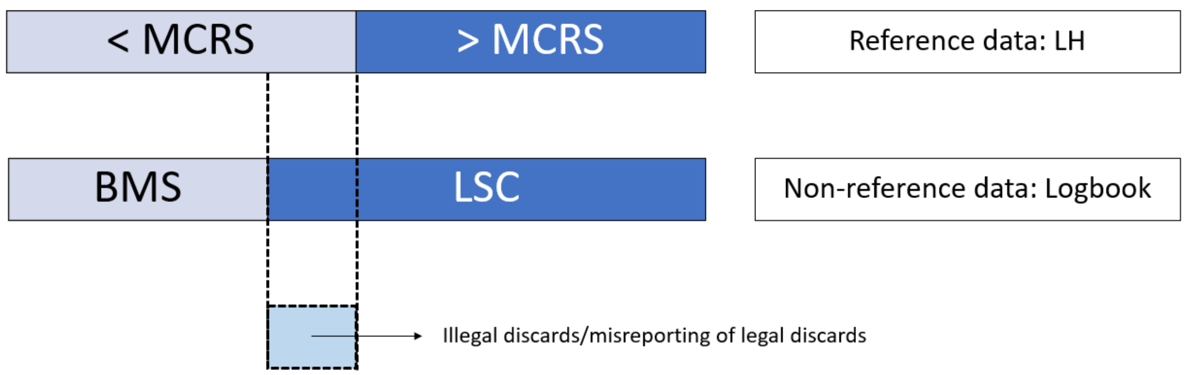

Figure 1. Estimation of illegal discard ratio using the last haul inspections (LH). BMS = landings of fish below the minimum conservation reference size (MCRS), LSC = landings fish above the MCRS.

Additionally, data on discard and landings submitted by EU Member States annually and made available by the Scientific, Technical and Economic Committee for Fisheries (STECF) of the European Commission have been used to obtain additional estimates of discards for the areas and fleet segments of concern. Data on discard levels presented by the International Council for the Exploration of the Sea (ICES) on the advice of fishing opportunities are also compiled for the stocks under study. Both the STECF and the ICES discard data are generally based on scientific data collection programs and include legal and illegal discards, as the focus of the sampling is to estimate removals from the fish stocks due to fishing.

These discard estimates based on scientific sampling are compared with the estimates obtained with the comparison between LH and logbook data, to check the consistency within the different sources of information.

Finally, the number and type of detected infringements related with the non-compliance with the LO are also considered. The aim of this methodology is to analysis what are the fleet segments with high number of suspected infringements, if there are any seasonal trends or other patterns in the infringement's typology.

Results and Discussion

Compliance with the provisions of the LO has been evaluated using the four sources of information described above. The use of discard data derived from direct observations, in the form of LH inspections, is the preferred method to assess compliance. but in many sea basins, there were not enough LH inspections carried out for all the areas and fleet segments under consideration to allow a robust estimate of discards. This was a recurrent reflection about the difficulty of performing inspections at sea, a problem that was made worse in 2020 due to the restrictions imposed by the COVID-19 pandemic, where sea inspections were, when conducted, reduced in time not allowing to perform the necessary verification of the catch size composition. The scientific discard estimates have been used in those cases where no (or very few) LH inspections were available. However, determining compliance using this information, which was collected to meet a different objective, may be problematic. The scientific information is collected to estimate the removals on a stock due to fishing and include both legal and illegal discards. The use of the trends (or lack of trends) in suspected infringements issued for non-compliance with the LO has provided very little additional information on compliance given the difficulties in detecting non-compliance with the LO. Fishers will not illegally discard during an inspection at sea and the occasional element of sea inspections prevent having an overall picture of the normal practices of handling the unwanted catches.

An additional issue is the difficulty of incorporating the provisions of the different exemptions available for the species of interest into the calculations of illegal discarding. These exemptions, in the form of de minimis or survivability have different reporting requirements and allow that some proportion of the fish caught (in some cases, the part of the catch below the Minimum Conservation Reference Size, in others, all catches) can be legally discarded.

Taking these caveats into consideration, the limited verified data and the lack of effective control and monitoring tools has been a recurrent problem when evaluating compliance with the LO. The introduction of Electronic Monitoring (EM) systems and/or control observers in some of these fleet segments could facilitate the collection of reliable reference data. EM systems could serve a dual purpose, not only as a monitoring tool to improve the reference data available but also as a control tool for effective enforcement of the LO, especially since traditional control tools have proven to be inefficient for enforcement purposes.

The use of other control and monitoring tools, such as remotely piloted aircraft systems (RPAS) combined with documentary checks, could also help to obtain a better picture of compliance.

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Marine Stewardship Council Fisheries Standard – the new Evidence Requirements Framework

Tim Davies, Elise Quinn, Ernesto Jardim

Marine Stewardship Council

Introduction

The Marine Stewardship Council (MSC) is a non-profit organization that set a standard for sustainable fishing. The science-based MSC environmental standard for sustainable fishing (MSC Fisheries Standard) offers fisheries a way to confirm sustainability, using a credible, independent, third-party assessment process. Fisheries that wish to demonstrate they are well-managed and sustainable compared to the MSC Fisheries Standard are assessed by independent Conformity Assessment Bodies. If certified, fisheries can use the blue MSC label on their products (Fig 1). This allows sustainable fisheries to be recognized and rewarded in the marketplace, and provides assurance to customers that their seafood comes from a well-managed, sustainable source. Fishery certification lasts five years from assessment, with fisheries audited annually during their certification cycle to review any changes in information and check on progress made against any conditions of certification.

Figure 1. The blue MSC label is only applied to wild fish or seafood from fisheries that have been certified to the MSC Fisheries Standard.

To achieve MSC certification, a fishery must have an effective monitoring system in place. A well-designed monitoring system should collect high quality information on a fishery's activities, such as what it catches, how long it fishes for, where it operates and whether it complies with management measures. In the Fisheries Standard v3.0 we have introduced ambitious new requirements on evidence to increase confidence in the assessment of a fishery's impact on aspects such as endangered, threatened and protected species, habitats and ecosystems, and whether it is compliant with management regulations.

These changes are focused around a new assessment tool - the Evidence Requirements Framework - that will enable assessors to evaluate the quality of information being used to certify a fishery as sustainable and well managed. Assessors will determine the accuracy of the information available. The framework leads assessors through an evaluation of the critical aspects of a fishery's information system, including the method of information collection, the extent of monitoring in time and space, and how the information has been reported and provided to the assessment team. As a minimum requirement for meeting the Fisheries Standard, all fisheries will need a monitoring system that is able to collect, report and verify catch information. Fisheries operating at best practice level must have a monitoring system that is designed to increase the precision of catch estimates, as well as provide a level of independent observation of catches. This new assessment tool and the enhanced evidence requirements will make it easier for assessors to evaluate information in a systematic way, and to report their findings consistently and transparently as part of the certification process.

Methodology

In 2018, the MSC began a formal, comprehensive review of the Fisheries Standard to ensure its fishery certification program remained relevant and credible (MSC, 2018). This process culminated in October 2022 with the release of the revised MSC Fisheries Standard v3.0.

The process included an internal review of the evidence used in the assessment of a fishery and how its quality is evaluated by auditors. This review found that guidance to support auditors in assessing information adequacy was limited and fragmented throughout the MSC Fisheries Standard, and concluded that a lack of clear instruction had resulted in differences in assessors' judgement and the transparency of their scoring. It recommended that these weaknesses be addressed to avoid creating inequality in the MSC program, and to ensure the MSC could be an important driver for improving fisheries monitoring programmes globally (MSC, 2020).

On the basis of these findings, the MSC undertook a major revision of its evidence requirements. This included a redesign of the information needed for the certification of a fishery and processes by which the quality of that information is evaluated. The result of this four-year process was the development of the MSC Evidence Requirements Framework, a new tool described below that will be used by auditing teams to ensure robust and consistent assessment of the evidence used in fishery certification (MSC, 2022).

Results and discussion

Using the Evidence Requirements Framework, auditors assessing fisheries against the Fisheries Standard v3.0 are required to determine the possibility that the information is biased (the extent to which systematic error is accounted for), and the possibility that catch estimates are imprecise (the extent to which random error is accounted for). Auditors are provided with a method to infer the extent of information trueness and precision, based on an evaluation of a fishery's information system. This includes how information is collected, managed and made available to the auditing team. In taking this systematic view, there is recognition that different monitoring approaches may achieve a similar result in terms of the accuracy of information collected.

The evaluation of trueness is intended to assess the possibility for bias to exist in the information, and to consider the extent to which it may affect information trueness. This follows the logic that if we understand potential for information to be biased, and the likely strength of its effect, we can make an inference on trueness. The lower the potential for bias, the higher the expected level of trueness. If bias is likely or known to exist in the information, the team must ascertain whether its effect is understood or can be anticipated, and reach a conclusion whether it is consequential to the trueness of information. There are several types of bias that may be relevant for the team to consider. Observation bias is a deviation from the truth that results during the process of observing and recording information. This can occur due to observer effects, the use of biased estimators, sampling design, data handling protocols or measuring errors. Response bias is the tendency for participants to respond inaccurately when providing information, in the sense of overestimating or underestimating a value. This can occur as a result of conflict of interest, the recorder or respondent's competency, questioning method and social or cognitive biases. Confirmation bias is the tendency to use information in a way that confirms a prior belief. This can occur as a result of selecting or favouring certain information, ignoring contrary information or biased interpretation.

The purpose of the evaluation of precision is to examine how a fishery's catch monitoring system works to reduce random error. Here, a catch monitoring system is defined as any approach that allows for the systematic collecting, reporting and estimation of catches on an ongoing basis. The focus of this part of the Evidence Requirement Framework is on how the monitoring system is designed to reduce the effect of random error on the precision of catch estimates. This follows statistical theory whereby the more that random error is reduced by the characteristics of the monitoring system, the higher the precision of catch estimates that are produced. Sources of random error that may affect the precision of catch estimates include heterogeneity in physical characteristics of the fleet, heterogeneity in where and when fish are caught, dynamics in stock distribution or catchability and the extent of statistical independence in catch observations (MSC, 2021). In order to account for these various sources of error, the auditing team is required to consider both the physical (e.g. sampling design, observation methods) and statistical (e.g. statistical procedures, estimators) aspects of the catch monitoring system.

While certain details of the processes and scoring mechanisms to assess trueness and precision are tailored to specific scoring issues, the same underlying approach is used to determine information accuracy throughout the Standard. This approach allows the Evidence Requirements Framework to deal with the full range of information types used in a fishery assessment and to apply throughout the Standard.

Key MSC documents

For specific details of the requirements in the MSC Fisheries Standard, MSC Fisheries Certification Process and MSC Fisheries Standard Toolbox (the document where the Evidence Requirements Framework sits), see the following summary information and links:

MSC Fisheries Standard v3.0: The MSC Fisheries Standard sets out requirements that a fishery must meet to enable it to claim that its fish come from a well-managed and sustainable source. The MSC Fisheries Standard applies to wild-capture fisheries that meet the scope requirements provided in Section 1 of the document. The MSC Fisheries Standard is comprised of the following core Principles:

- Principle 1: Sustainable target fish stocks
- Principle 2: Environmental impact of fishing
- Principle 3: Effective management

MSC Fisheries Certification Process: The Fisheries Certification Process define the process requirements for Conformity Assessment Bodies to assess fisheries against the MSC Fisheries Standard. The key purposes of this document are to establish a defined process that ensures CABs operate in a consistent and transparent manner.

MSC Fisheries Standard Toolbox: A suite of mandatory and optional tools that score or inform the scoring of Performance Indicators during the assessment of a fishery against the MSC Fisheries Standard, including the new Evidence Requirements Framework.

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What about marine litter? Addressing this issue through a Fisheries Observer Program

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[2]OKEANOS UAç - Research Centre in Marine Sciences of the University of the Azores
[3]OMA - Sea Observatory of the Azores

Under the United Nations Environmental Program (UNEP) marine litter has been defined as "any persistent, manufactured or processed solid material discarded, disposed or abandoned in the marine and coastal environment". Before sinking or washing ashore marine debris floats at the surface of the sea, being transported over long distances by winds and ocean currents. In recent years, marine litter has become recognized as one of the major anthropogenic stressors that jeopardize ocean resources and consequently fisheries all over the world. This issue has become central within the environmental European policies, which is clearly represented in the adoption of the European Marine Strategy Framework Directive (MSFD). Due to its isolated geographical location and its complex oceanographic structures, the Azores archipelago, in the North Atlantic, seems to be an area prone to the retention of floating marine litter. The Archipelago is a biodiversity hotspot for many marine megafauna (including fisheries target species) that can be easily injured by marine debris which turn this into a very sensitive area that should be well monitored. In fact, this action has been demanded for each member state within the scope of MSFD since 2016.

The Azores Fisheries Observer Program (POPA) is funded by the Regional Government and managed by the Institute of Marine Research (IMAR). Provides crucial information for decision makers, scientists, NGOs, industry and fishermen about the main commercial fisheries in the Archipelago since 1998, being specially focused in the pole and line tuna fishery. In the face of the European Union marine litter monitoring challenge, the Program was asked to assume the task, which it did further incorporating other initiatives that addressed the marine litter issue in a broader perspective.

Since 2015, marine debris standardized surveys were integrated in the fisheries observers routine, replanning general sightings effort ensuring working hours were not increased. Surveys consisted of 10 minutes visual transects performed every 2 hours up to six times a day where floating macro litter was recorded by each observer. Data collected supported the first scientific characterization of the distribution and composition of floating macro debris off the Azores and Madeira islands (Figure 1 and 2).

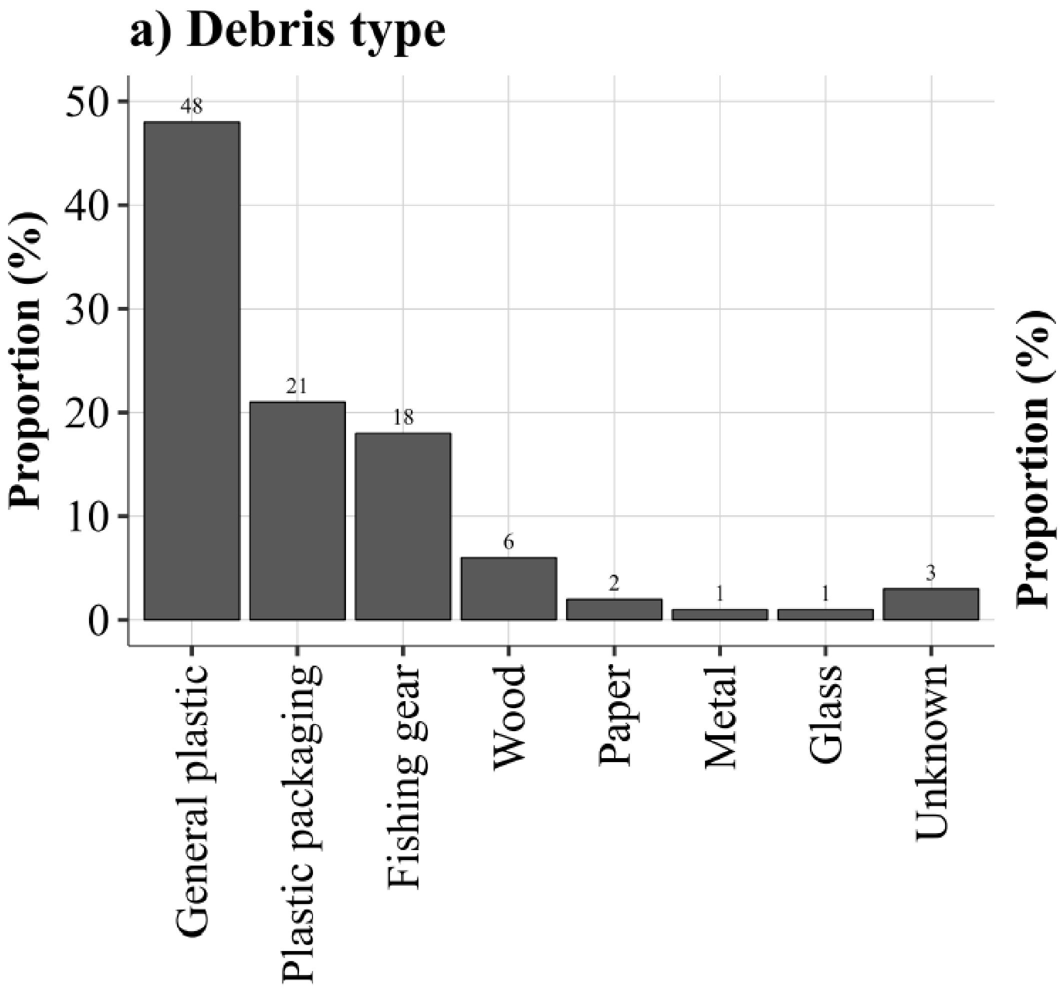

Figure 1 - Histogram of the type of the macro marine debris sighted during the three years of sampling (Chambault et al, 2018)

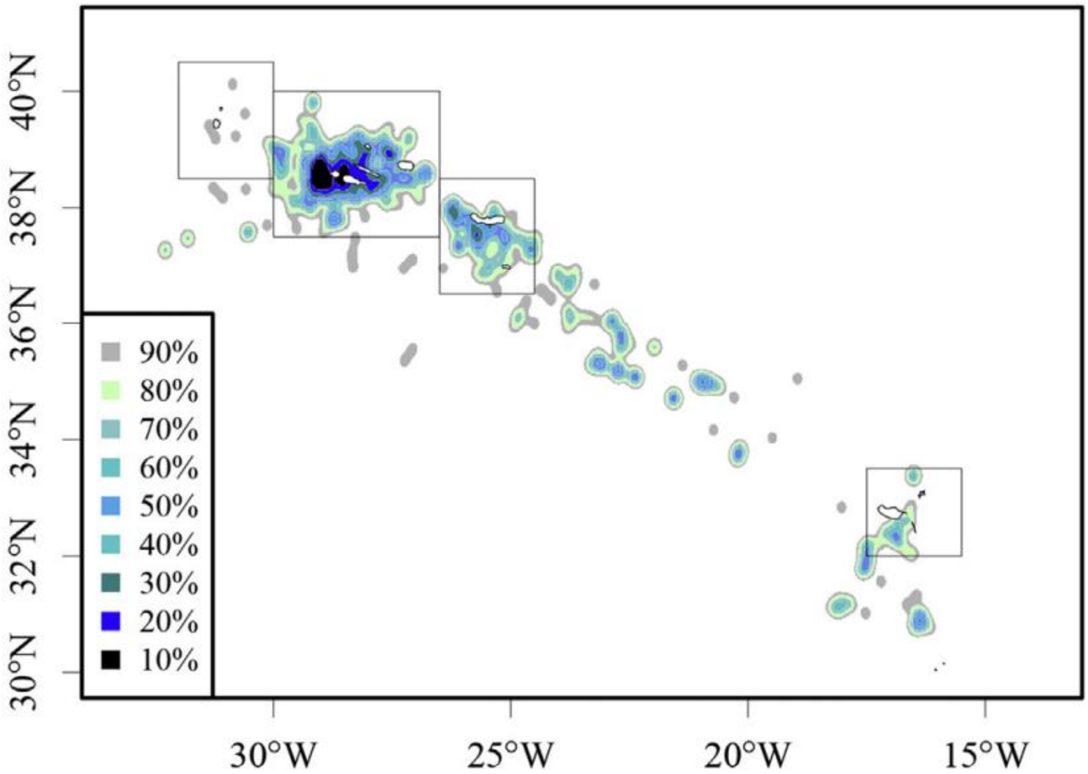

Figure 2 - Kernel density contours of the floating debris over the three years of sampling (Chambault et al, 2018)

Plastic items were prominent and marine debris showed higher densities close to shore but, overall, the amount of floating marine debris around the Azores was lower compared to areas found closer to continental shelves. Moreover, most of the floating marine debris seemed to have origin in faraway land-based sources and fishing activities. While monitoring floating marine litter, POPA in partnership with the Azorean Maritime Policy Affairs Directorate implemented a “zero waste” contest, where observers collect data through inquiries about debris management on board fishing vessels, highlighting among fishers the importance of adequate management of residuals.

Since the fishing industry is recognized as one the primary sources of at sea marine litter, mainly through its contribution via abandoned, lost or otherwise discarded fishing gear (ALDFG) and since the Azores were already engaged in addressing the marine litter issue, International Pole and Line Foundation (IPNLF) established a partnership, with POPA, IMAR and the Sea Observatory of the Azores (OMA) aiming data collection about lost fishing gear during pole and line fishing events, within a pilot project funded by Waitt foundation. A new form on lost gear was added in 2019 to the already existing fishing forms and observers started to record eventual fishing gear losses in each fishing event. After analyzing more than 1000 fishing events, IMAR researchers found that angler lost some nylon monofilament line in only 1.4% of the total number of events and that for every thousand tons of tuna only 0.3 kg of nylon entered the marine environment. Those results further evidenced the low environmental impact and associated sustainability of this fishing method leading to the creation of another project, coordinated by OMA and IMAR, in partnership with IPNLF, Fishers Associations and LOTAÇOR, funded by Bioocop and Organico where fishers were encouraged to fish for floating marine litter to compensate for their own ALDFG production. As expected, the marine debris items caught in that contest rapidly surpassed the ALDFG fleet production, leading in 2021 to the recognition of the Azorean pole and line tuna fishery as the first Plastic Neutral fishery in the world.

The multispecific strategy implemented by the Azores Region, addressing the marine litter issue through its own fisheries observer program proved to be quite robust and complete, providing results not only about the spatial distribution and composition of marine debris but also about its management and production on board fishing fleets. It also made it possible to recognize the most important fishery in the Azores as one of the lowest ALDFG production in the world, which highly values this artisanal activity.

Effects of Kelp Forest Collapse in California Groundfish Fisheries

James Grunden

Alaskan Observers, Inc., Westcoast Groundfish Observer Program

Introduction

Essential fish habitats like kelp forests are declining world wide due to changing oceanographic conditions and their disappearance could have drastic consequences for fisheries that rely on them. In 2014 a marine heat wave made its way to northern California and increased sea surface temperatures by 2.5 C above normal for 226 consecutive days (Rogers-Bennett and Catton 2019). This warm water event coincided with a sea star wasting disease that decimated sea star populations along the west coast of North America, with some sea star species being major predators of sea urchins. A subsequent explosion in purple urchin (*Strongylocentrotus purpuratus*) populations combined with warm, nutrient poor water led to the decline of the main canopy forming kelp in the region, bull kelp (*Nereocystis luetkeana*). Bull kelp forests in the region between Ft. Bragg, CA and Bodega Bay, CA experienced the highest losses with decreases in canopy cover over 95% recorded and were declared collapsed in 2015 (Rogers-Bennett and Catton 2019).

Information on the effects from the loss of kelp forests on commercial near shore groundfish fisheries is limited and there is urgency to determine any changes to fish stocks. This study aims to understand what is happening to these regional fisheries since the loss of kelp forests in 2015.

Methodology

Commercial landings data was requested from the California Department of Fish and Wildlife (CDFW) for near shore fish species that inhabit kelp forests including: black rockfish, blue rockfish, black and yellow rockfish, China rockfish, gopher rockfish, grass rockfish, kelp greenling and cabezon. The dataset was limited to shallow water gear types that are representative of fisheries operating within or adjacent to kelp forest habitats and included: hook and line, vertical hook and line, set long line, diving and fish traps. Data was requested for ports in the region that saw the greatest decline in kelp forests from Ft. Bragg, CA to Bodega Bay, CA for years 2010 to 2021. Additionally, regional quota allocations for the selected species were researched from the Pacific fisheries information network's (PacFIN) database in order to determine how fishing effort has changed over the time period.

Results

Figure 2 shows CDFW landings and PacFIN regional quota allocations for cabezon, kelp greenling, black and yellow rockfish and gopher rockfish for years 2010 to 2021. Landings in pounds are in solid lines on the left y-axis with corresponding PacFIN regional quota allocations in pounds in dotted marked lines on the right y-axis. The vertical red dotted line at year 2015 represents when kelp forests were declared collapsed in the study region. Landings for all species show varying degrees of decline after 2015, but then show increased landings in years 2019 to 2020. Interestingly, quota allocations for cabezon and gopher rockfish show increases during the same time that landings for all species increased, indicating that an increase in quota could be driving the increase in landings for those species.

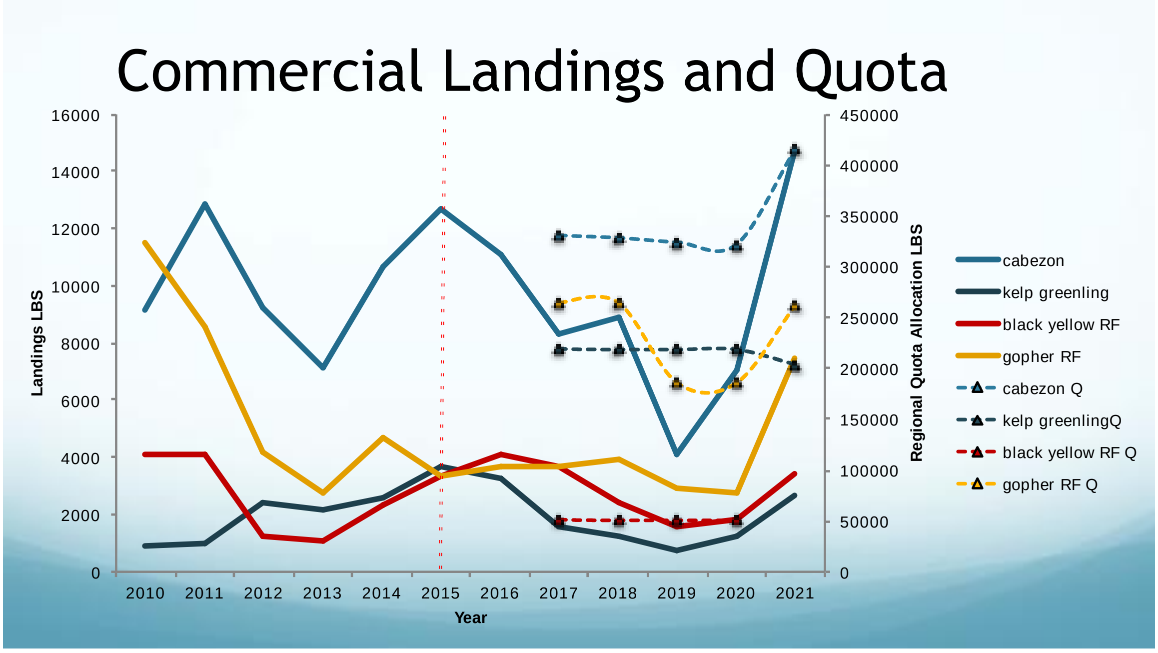

Figure 2. Linear graph representing CDFW commercial fisheries landings for cabezon, kelp greenling, gopher rockfish and black and yellow rockfish in solid lines on left y-axis and PacFIN regional quota allocations in dashed lines on the right y-axis from 2010 to 2021.

Figure 3 shows landings and regional quota allocations for black rockfish, blue rockfish, China rockfish and grass rockfish. Landings in Figure 3 follow a similar trend to landings in Figure 2, with varying declines after 2015 that are followed by increased landings in years 2019 to 2020. Similarly, regional quota allocations for black rockfish and blue rockfish increased during the same general time period that landings increased for all selected species.

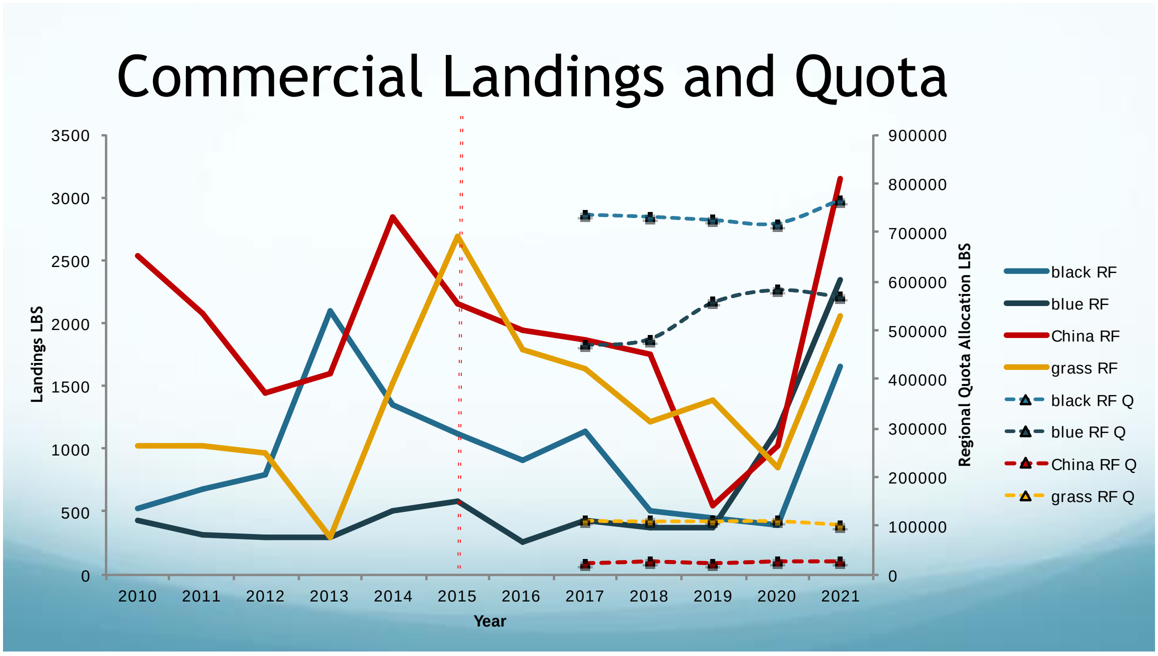

Figure 3. Linear graph representing CDFW commercial fisheries landings for black rockfish, blue rockfish, China rockfish and grass rockfish in solid lines on left y-axis and PacFIN regional quota allocations in dashed lines on the right y-axis from 2010 to 2021.

The increases in quota allocations for four of the eight selected species (cabezon, gopher rockfish, black rockfish and blue rockfish) appear to occur during the same time as all species landings rebounded in 2019 to 2020. This could be due to the fact that these species inhabit the same environment and as quota and fishing effort increase for half the species, landings could increase for all the species as they are caught together and all are retainable.

Additionally, offload receipts related to the landings data were requested and are shown compared to landings in Figure 4. The number of offloads related to landings follows a similar trend for all selected species. General declines in landings after 2015 were followed by an increase in landings after 2019 up to 2021. This trend in landings follows the general trend in the number of trip offloads during the same time period, indicating that fishing effort is responsible for changes in landings as oppose to the health of fish stocks. Interestingly, the increases in regional quota allocations for cabezon, gopher rockfish, black rockfish and blue rockfish also occur around the same time as the most recent rebound in landings and number of offload receipts. This suggests that increases in quota could be driving the increases in the number of trips and landings for all species. These similar trends lead me to believe that the fluctuations in landings are the result of fishing effort and are not indicative of fishery stock health.

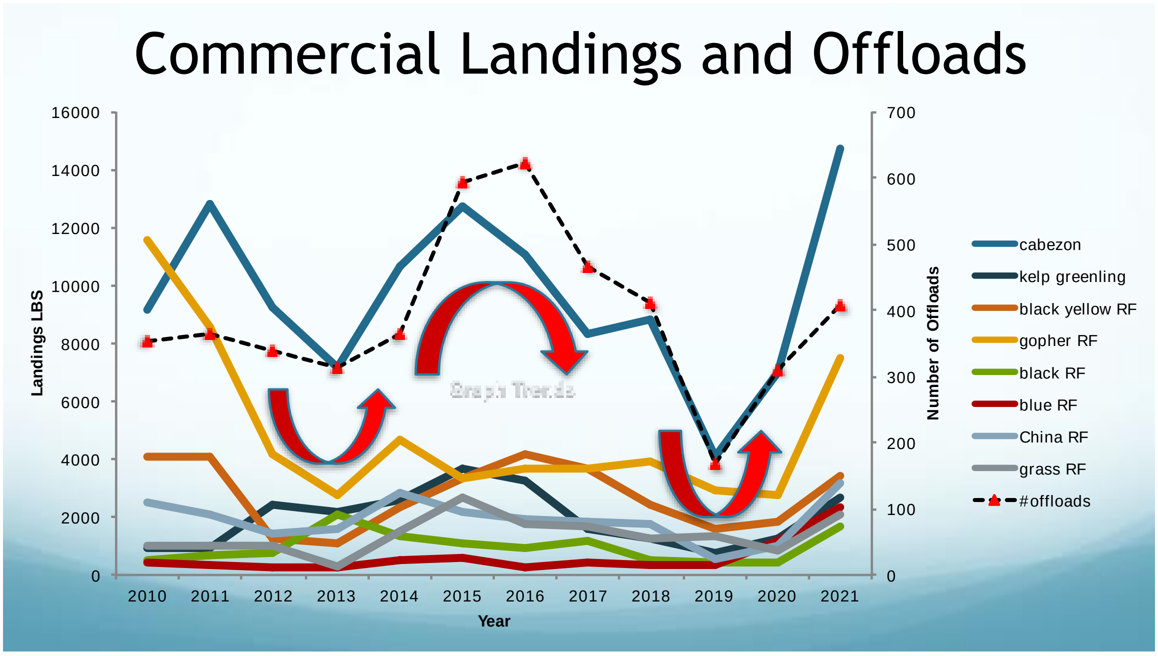

Figure 4. Linear graph representing CDFW commercial landings for cabezon, kelp greenling, gopher rockfish, black and yellow rockfish, black rockfish, blue rockfish, China rockfish and grass rockfish in solid lines on left y-axis and corresponding number of offload receipts in dashed, marked line on the right y-axis from 2010 to 2021.

<u>Discussion</u>

Absolute conclusions regarding the stock health of the selected near shore fish species could not be established due to the lack of specific fishing effort data. Vessels participating in these fisheries are not required to submit logbooks, so true fishing effort could not be determined and a catch per unit effort could not be calculated in relation to landings. In the absence of a calculated catch per unit effort the similar trends in landings, number of offloads and quota limits lead me to believe that fishing effort drives fluctuations in landings. If changes in landings are the result of fishing effort that could mean fish stocks are in good health since the loss of the kelp forest, but that may not be the case for the future and could spell trouble for these fisheries.

Many of the selected species in this study, especially rockfish, are long lived. Lifespans of these fish can range from 20 to 80 years and we may not see the full effects from the loss of kelp habitat for another decade or more. This is because kelp forests are essential fish habitats that provide crucial structure for recruitment of young fish as well as shelter and foraging grounds that support them as they grow to enter the fishery.

My study opens up more questions on how fisheries managers can capture the effects from ecological changes on such a small spatial scale in order to effectively manage fisheries in localized areas. Additional requirements for fishers to disclose fishing effort information would be the first step in to fully understand the health of fish stocks. This role could be filled by electronic monitoring technology that would automatically record effort information in remote areas or on smaller vessels. Currently in California, agencies are implementing an online digital logbook where fishers enter effort information on a phone app, which is then submitted to an online database when they reach shore.

The loss of kelp forests in northern California happened quickly and was too fast for policy changes to take place. I would argue that a new focus or increase in attention be given to fisheries that exist in vulnerable habitats that are at risk of change or disappearance. If there are losses to fisheries due to ecological changes then a baseline dataset is important for restoration and stock rebuilding efforts. Data is like money in the bank, it may not seem important today, but long term datasets become important in the future as baselines change or shift.

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Evolution of the diagnosis, regulation and control of discards and bycatch in Chilean fisheries

Luis Cocas

Undersecretariat for Fisheries and Aquaculture, Government of Chile

<u>Introduction</u>

Given the current levels of fishing effort and a general lack of management, discards and incidental bycatch have become global issues that threaten fisheries sustainability. Despite its importance the problem doesn´t show significant progress over time as evidenced by different FAO global assessments, with currently about 10% of world catches being discarded (Pérez Roda et al., 2019). The Interaction of fishing with sea birds, marine mammals and sea turtles may also be critical in some places of the world, which on top of other environmental pressures, have many of these species with conservation problems. Therefore, managing discards and incidental bycatch is a must for a fishing nation. But first is required the collection of unbiased and independent data on what happens at sea during fishing operations since these issues are invisible at landings which is where most of the fishing monitoring has focused in the past.

Aware of these conditions, also following the recommendations of FAO and other fisheries forums and within the framework of the implementation of a fisheries management strategy with an ecosystem approach, aimed at guaranteeing ocean´s sustainability and food security, Chile has developed since 2012 a successful process of diagnosis, reduction and control of discards and incidental bycatch in its national fisheries. This process has involved the joint efforts of the regulatory (SUBPESCA), research (IFOP) and control (SERNAPESCA) agencies along with a collaborative work with the fishing users, leading the country to the gradual solution of the problem.

Furthermore, considering the challenges of controlling and registering discards and incidental bycatch at sea, it was recently incorporated the mandatory use of EMS (Image Recording Devices - DRI and Electronic Logbook System - SIBE) to control compliance, with differentiated application depending on the type of fleet, together with the maintenance and enhancement of human observation programs for scientific purposes (**Figure 1**).

These new technologies to collect, register, manage and analyze fishing data are providing a set of possible solutions to update and modernize the fisheries data systems of the country and to significantly expand the collection and analysis of information, also for research and management, creating an opportunity to coordinate and enhance the work of the fisheries management agencies, around the maximization of the use of the information that can be obtained from the new technological monitoring tools.

<u>Methodology</u>

There has been a 20-year evolutionary regulatory framework that has been fundamental in the development of discard and bycatch management to its current state.

In 2001 the term discard was first introduced in the Chilean legislation under one approach of a general prohibition of discarding that did not distinguish between species or sizes.

Heavy sanctions to offenders and the lack of an extensive system to monitor compliance with this regulation at sea, made fishers uncooperative and consequently the real extent and causes of discards remained unknown to the fishing authorities. In recognition of these restrictions, the Chilean government reviewed the fisheries law in 2012, and through the law N° 20625/2012, incorporated a new step wise approach to solve the problem. In a first stage this approach considered exceptions to the discard ban, conditional on a minimum of two years fishery-based research monitoring programs, by observers on board, to quantify and identify the causes of discards and incidental bycatch. The exemption to penalties was included to prevent atypical behavior by crews that could bias the results and to gain the trust of fishermen. However, once the research programs conclude, the exemption of sanctions ended (**Figure 2**).

The background obtained through the research programs allowed to develop, at a later stage, mandatory reduction plans for these practices, tailored for each fishery. These reduction plans include *i)* management and conservation measures along with the technological means (such as the use of devices, excluders, handling protocols, etc.) necessary to reduce discards of both target and non-target species as well as the incidental bycatch of seabirds, marine mammals and sea turtles, *ii)* a program for monitoring and follow-up of the plan's performance, *iii)* an assessment of the measures adopted to reduce discards and incidental bycatch, *iv)* training and dissemination programs, *v)* codes of good practices during fishing operations, and *vi)* incentives for innovation in systems and fishing gear, whose objective is the mitigation or reduction of discards and incidental bycatch.

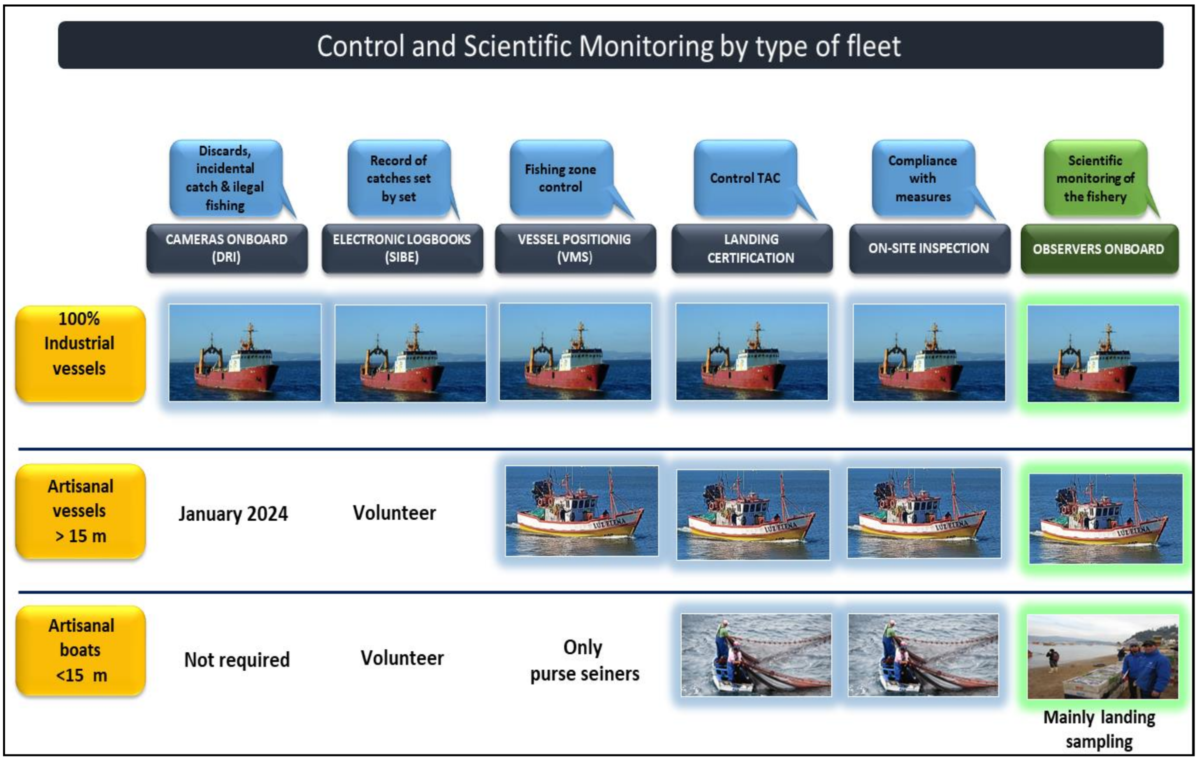

Figure 1. Monitoring tools differentiated by type/size of fleet/vessels to control compliance with fishing regulation (highlighted in blue) and to collect fishery dependent data for scientific purposes (highlighted in green), implemented in Chilean fisheries.

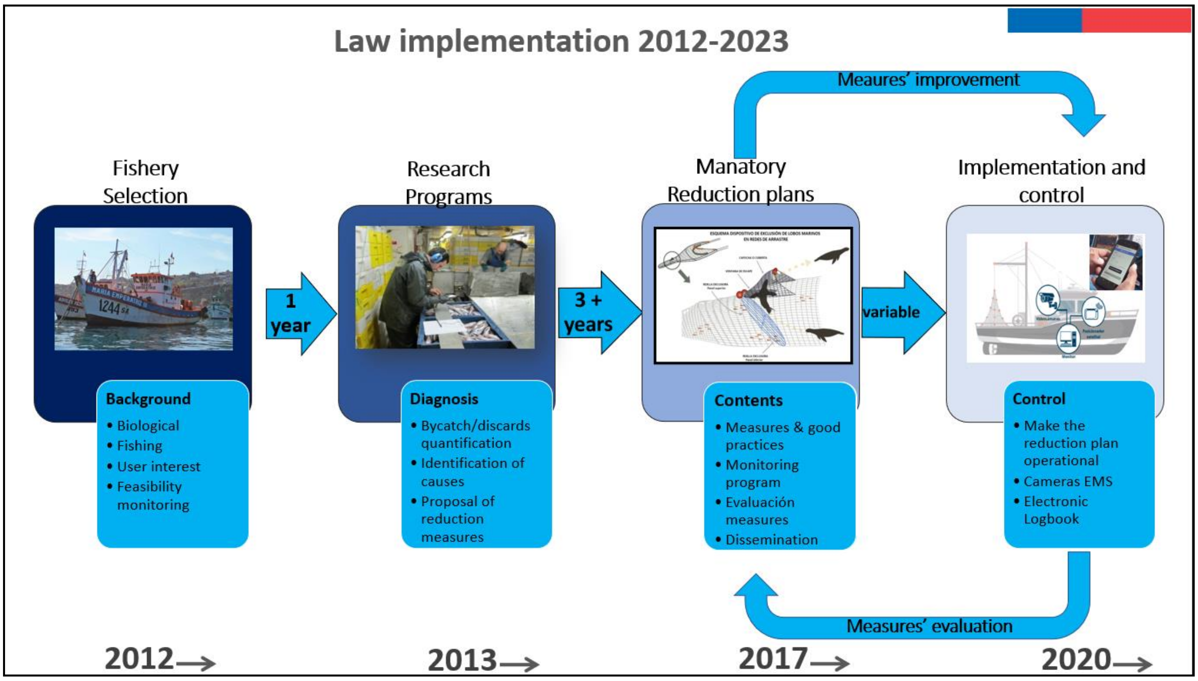

Figure 2. Stepwise approach implemented in Chile to diagnose, reduce, and control discards and incidental bycatch in fisheries.

In a final stage and considering the challenges of controlling and registering discards and incidental bycatch at sea, the law N°20625/2012 also incorporated the use of Image Recording Devices or cameras onboard (DRI) (**Figure 3**). To implement the DRI, in 2015 a Supreme Decree N° 76/2015 established the requirements for these systems on both industrial and artisanal fleets. This regulation set out the DRI's components, DRI's technical and design requirements, minimum number, and location of cameras by fishery, characteristics of collection, processing and confidentiality of images, obligations to vessel owners, the roles of SERNAPESCA, requirements for removing, downloading and processing DRI's information, penalties for non-compliance, and requirements for external entities that eventually may get involved in the images review. In Chile, although the law allows the participation of third parties in the images review, currently this task is being performed exclusively by the government, through SERNAPESCA, while is recognized that the experience gained from conducting review internally would guide any future competitive outsourcing process. There are also a set of complementary resolutions from SERNAPESCA, like resolution N° 3885/2018 that established the unique technical standard for the DRIs, or resolution N° 5095/2018 that established the procedure for accreditation of DRIs, along with a series of additional resolutions that established requirements for the location, height, direction and angle of each camera by fishery, type of vessel and fishing gear in fishing vessels, among others. Finally, a resolution from SERNAPESCA N° 5930/2019, established the start date for the entry into force of this control system (DRI), as January 1st, 2020

In addition, among other modifications to the Fisheries Law in 2013, through Law N° 20657/2013 (Article 63 letter a), it was incorporated the obligation for vessel owners to report their catches and landings, which in the case of industrial fleets shall be in logbooks of the type electronic (**Figure 3**). Likewise, it was established that a regulation must determine the information that the electronic logbook would contain and that SERNAPESCA shall establish the information's delivery opportunity and the procedures to determine and settle the differences between the catch and landing information reported by vessel owners. Consequently, through the Supreme Decree N° 129/2013, the specific regulation that regulates the requirements for the delivery of fishing information to SERNAPESCA by the vessel owners, was established. In the case of the industrial fleets, the information must include the identification of the vessel owner, as well as the information of the holder of the fishing licenses, the dates of departure and landing, port of departure and landing, fishing gear and also for each fishing set; the amounts of catch by species or groups of species, the geographical position, the date and time of setting and hauling of each fishing set, the amounts discarded by species or groups of species and the incidental bycatch, if any. The electronic logbooks, mandated by the Law, were formally established for the first time in 2015 by Resolution N° 114/2015, and were later replaced in 2020 by an electronic logbook provided by WWF Washington D.C. through Resolution N° 267/2020. This last resolution establishes the Electronic Logbook System (SIBE) currently in use and determines the opportunity and conditions for the delivery of fishing information through this tool. Additionally, it establishes the definition and components of the SIBE (SIBE web and SIBE mobile), its characteristics, the minimum conditions that the mobile devices in which the SIBE will be used, the conditions for downloading and installing the application, the profiles of the different users of the system, their responsibilities, and the procedures when there are failures, among others. In relation to the artisanal fishing fleets, the fishing information must be delivered in paper logs, although they can voluntarily use SIBE, for which pilot projects are being developed.

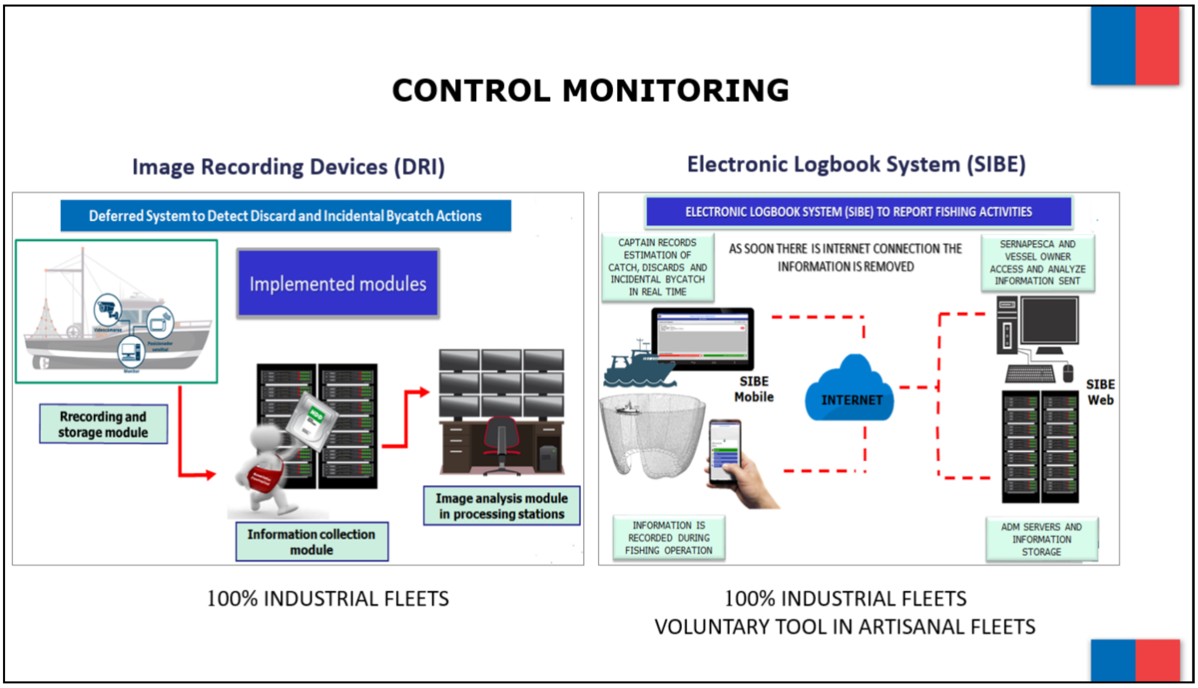

Figure 3. Image Recording Devices (**DRI**) to detect discard and incidental bycatch at sea and Electronic Logbook System (**SIBE**) to report fishing activities (including discards and incidental bycatch) in Chilean fisheries.

It is important to note that the observer programs, carried out since 1990, were extended with the law N° 20625/2012, but have continued with the sole objective of collecting biological and fisheries data to be used exclusively in scientific advice for management, without any jurisdiction with compliance (**Figure 4**).

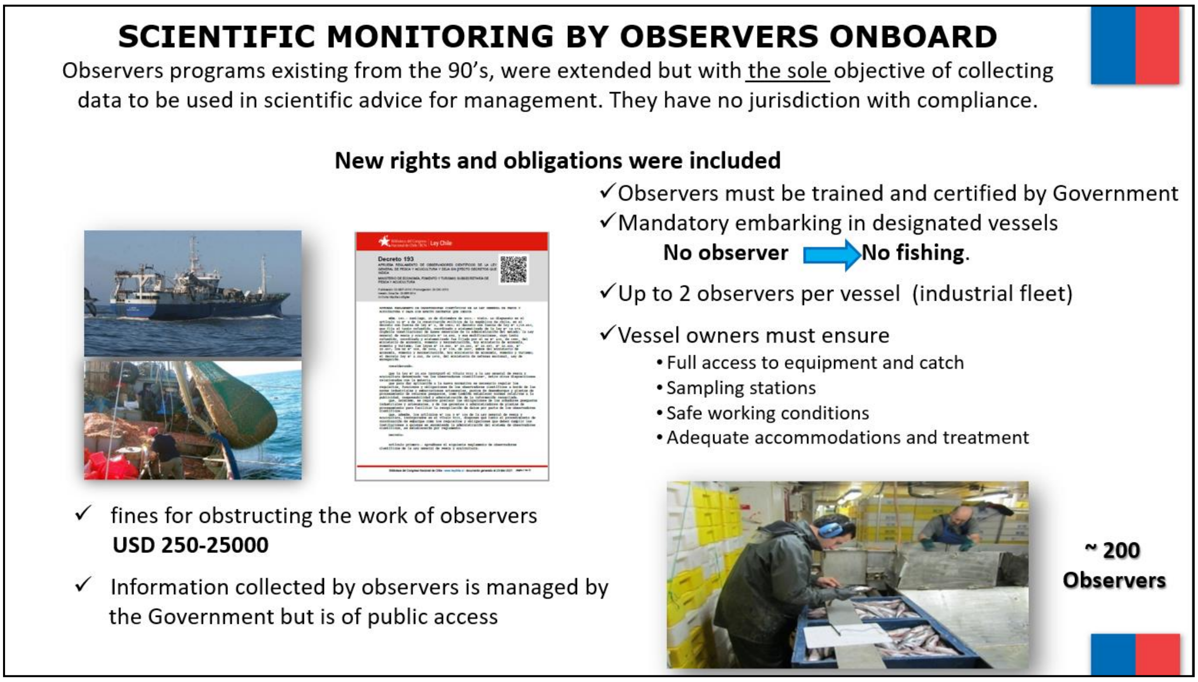

Figure 4. General overview of the scientific observer program in Chile to monitor fishing activities.

Having finished several fishery-based research monitoring programs by observers on board as required by law N° 20625/2012, by 2022, 11 discards and incidental bycatch reduction plans have been established, covering 17 fisheries both artisanal and industrial, while other fisheries are still in the research (exceptions ban) phase. Additionally, the lists of species subject to the reduction plans for each fishery and the regime in which they are (prohibited discard, authorized discard, mandatory return to the sea) are updated annually.

Results and Discussion

During the implementation process of the law N°20625/2012, that affords discards and incidental bycatch, and the new monitoring systems (DRI and SIBE) to control these practices, there has been a close collaboration and feedback between the different agencies related to fisheries management in Chile, that has allowed to change and adapt fishing regulations, preventing discards of regulatory origin, while increasing compliance. Likewise, the establishment of some measures, such as the use of devices to reduce incidental bycatch of marine mammals or seabirds, has been designed in such a way that they can be efficiently monitored and controlled by the EMS and the analyst teams. In other cases, improvements have been made once the measures have been implemented, like the addition of cameras to detect specific issues in some fisheries or the requirement of specific handling protocols by crews, functional to the DRI. The EMS information has contributed to the management agencies' understanding of behaviour patterns of the fleets with regard to discards and incidental bycatch and to identify individuals associated with non-compliance. These conditions have supported a significant improvement in undesirable practices at sea in a way that was not previously possible. Feedback loops, including communication between hardware installers and video reviewers, or data users communicating back to fishers (i.e. ensuring proper catch handling and data quality) have been key elements to the success of the program. In addition, feedback to the industry about the program implementation, including access to data and videos, has improved fisher's knowledge of the EMS program, increased transparency, and improved fisher's efficiency. It is also important to note that providing feedback to fishers has allowed to identify weaknesses or deficiencies of the systems that have been improved.

Remaining challenges include species identification in some fisheries operating conditions and catch (and discard) identification and quantification using DRI imagery for quota deductions. Until now it has been a general deduction of discards in the establishment of TAC, in fisheries where discarding occurs, but the goal is to move towards an individual deduction, which requires an accurate measurement of discards for each vessel. An additional challenge relates to the use of DRI for controlling other fishing regulations and illegal fishing as required by the 2019´s review of the fisheries law (that extended the DRI´s scope), being the biggest challenge the incorporation of the artisanal fleets to this scheme by 2024, according to law requirements, which is any artisanal vessel bigger than 15m in total length.

Building on the knowledge acquired during the first two years of the EMS program in the industrial fleet, new approaches to sampling imagery for review are being explored, such as the development of fleet-specific criteria and a risk-based process for sample selection. The program will continue to cover 100% of industrial vessels and their fishing activity, while review technologies (using machine learning and artificial intelligence) will be trialed in pilot projects starting in 2022 in the artisanal fleet, supported by The Nature Conservancy (**Figure 5**). Work underway also includes integrating various electronic monitoring and reporting tools. While the program currently uses hard drives for storage, transitioning to wireless transmission over 5G networks and cloud storage are foreseen as future steps, as well as implementing prereview within the DRI system onboard vessels and improving image quality to support a broader range of monitoring objectives. On the other hand, the recent implementation of technologies (DRI and SIBE) to collect, register, manage and analyze fishing data associated with the control of catches, discards and incidental bycatch, has provided a set of possible solutions to update and modernize the fisheries data systems and significantly expand the collection and analysis of information, also for management and research purposes, creating an opportunity to coordinate and enhance the work of the three national fisheries management agencies (SUBPESCA, SERNAPESCA and IFOP) around the maximization of the use of the information that can be obtained from the new technological monitoring tools.

The rapidly changing characteristics of the fisheries and their environment are forcing the need for higher spatial and temporal resolution of fishery data to account for growing uncertainty and to enable management agencies to manage adaptively. In this way, the most precise collection of data is required, as well as its processing, analysis and the preparation of faster and more advanced reports that derive in the design of more efficient mechanisms to share the results that allow responses to be given in times close to the real time. In this context, starting in 2022, the use of EMS for scientific purposes and their integration with traditional fishery-dependent data collection programs to support fishery monitoring and management has begun to be explored through the development of a specific research projects.

Figure 5. EMS pilot project implemented in 2022 in the artisanal Chilean seabass fishery.

The experience gained by Chile in the diagnosis, reduction and control of discards and incidental bycatch recommends the gradual implementation of this process, under transparent framework policies, where the visions of the different stakeholders are considered and the realities of each country are taken into account; technical, human capacities economic and cultural. Also recommends exploring the use of tools like EMS to improve the monitoring´s coverage of the fishing fleets. However, it is recognized that the use of these technological systems for purposes other than control, such as obtaining scientific information and collecting fishery-dependent data, still requires intense work on the design of current monitoring programs, the exploration of the use of complementary technologies such as computer vision (CV) or machine learning (ML), and its integration with traditional human observer programs in use.

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Resolution N° 5930 of 2019 (DRI) from the National Fisheries and Aquaculture Service
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Abstracts of oral presentations that did not provide Extended Abstracts

Fisheries observers as enforcement assets: 21 years of lessons from the North Pacific

Craig Faunce

National Oceanic and Atmospheric Administration, United States

Multiple studies have demonstrated a positive linkage between the intensity of governance and the status of stocks that support robust fisheries. Fisheries monitoring and enforcement are a big part of that governance because they combat illegal, unregulated and undocumented fishing. Observers are a visible presence towards increasing compliance with maritime law, and report greater and more diverse potential violations than enforcement agents where they have the dual role of enforcement asset and data collector. Yet despite the benefits they enable, many fisheries monitoring and enforcement programs face criticism for a lack of transparency and accountability. We identified patterns and drivers of observer reporting of potential violations from a review of 20,806 statements from a large observer program (30 – 45k days yr-1) for the duration of electronic records. This presentation will provide a high-level summary of the lessons learned from this review: the difficulty in using the data, whether trends in reporting reflect compliance, how regulations affect observer reporting, and how to improve efficiency - that should serve as a useful guide for other enterprises that use observers as enforcement assets.

Open Discussion Session

Dave Colpo to Luis Cocas
Q: What motivates artisanal fishers to get involved with the EM programme?
A: Joining the programme gives credibility to the fishers (trusts, transparency and market demands related to the requirements established by the US Marine Mammal Protection Act to the nations exporting fish and fish product to that country). The vessel also gets the internet as a bonus. Export to certain countries also requires minimum monitoring coverages and EM is a good alternative to be on artisanal vessels.

Isaac Forster to Craig Faunce
Q: What is the coverage rate like in Alaska?
A: Rates have been steady. Try to treat each record as the numerator, and each observer deployment taken as effort.

Victor Ngcongo to Elise Quinn
Q: How does one achieve 30% coverage? Does land based observing count?
A: Work with industry. Land based observing has to be independent.

Jorgen Dalskov to Elise Quinn
Q: Are fisheries still certified despite lots of discards?
A: Certification is based on target stock, environmental impact, and enforcement compliance. Assessor will individually assess each critical area.

Lisa Borges to Carla Damaso
Q: How did the observers respond to the extra task of observing and collecting litter?
A: Communicate the importance; Started with just sighting 40 min/day.
James Grunden added: If that's priority, then observers will allocate time and effort

Jennifer Ferdinand to James Grunden
Q: Was this your own project out of interest or is it an organisational project?
A: I was a research diver and noticed kelp forest decline. The increase of fish landing since 2019 surprised me so I started this project on my own.

Eric Brasseur to whole panel
Q: For artisanal fishers, what is the benefit of having EM/E-log?
What benefits are there to vessels for voluntary EM monitoring?
A: Real time access to catches, composition, and quota consumption. Allows fishermen and owners to have real time information and maximize effectiveness of fishing. Also allows enforcement to target violators.

Zane Duncan to Luis Cocas
Q: How do you manage H&S risk on fishing vessels when deploying observers?
A: No major issues thus far. Most coverage is on larger vessels. Constant communication with observers and field coordinators, EPIRBs are provided to each observer along with safety equipment. If vessel is unsafe, observer does not get deployed.

Tiffany Vidal to Elise Quinn
Q: How do you identify fisheries that catch protected species? Does out of scope species include finfish?
A: Early assessment looks at the whole catch and any relevant information. Any indication of interaction, they would be put in that category. Out of scope species does include finfish

Matt Walia to Carla Damaso
Q: How would we help prevent garbage in the southeast US and how do we get fishermen to bring back litter?
A: Have observers on board to monitor compliance and report violations

Josh Weisner to Elise Quinn
Q: To reach 30% coverage, would coverage from EM be adequate?
A: At the moment the requirement is “independent observation”, so yes there is room for EM to be included.

Jimmy Freese to Luis Cocas
Q: What is the origin of the protected species data?
A: There is a FAO technical paper published on this (A third assessment of global marine fisheries discards (Pérez Roda, et al., 2019).
Steve Kennelly added that he wrote that paper and the information comes from published material and uses mostly observer data

Paul Oryem to Carla
Q: What happens to the litter collected?
A: Recycled, reused. There are facilities to collect and repurpose to other items. A lot is reused by fishers since a lot is fishing gear.

Poster Presentations - Extended Abstracts

Monitoring fishing activities of a distant water fleet in a small-scale, multi-gear, multi-species fishery: the case study of Saint-Paul & Amsterdam

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The fishery context
The Saint-Paul rock lobster (*Jasus paulensis*) supports a profitable commercial fishery in the French Exclusive Economic Zone (EEZ) of Saint-Paul & Amsterdam (SPA). Located more than 1,700 miles from *L'Île de la Réunion* (South-East Indian Ocean), the French administration manages the fishery by setting (1) annual Total Allowable Catches for rock lobster and target fish and (2) technical restrictions to fishing effort (e.g. authorized fishing gears, trap mesh size, minimum legal size, mandatory logbooks. Selles et al. in press). The fishery operates in a nature reserve (NR) that requires significant monitoring of impacts of the fishery on target resources, by-catch species and the marine ecosystem. The development of an ecosystem observation program is also a prerequisite for obtaining Marine Stewardship Council (MSC) certification. This article presents the Southern Fisheries Ecosystem Observation Program (POEPA) for the fishery based on the "Ecosystem approach to Fisheries" (EAF) paradigm (FAO 2003).

Recently, one large factory vessel operates on the reduced fishing grounds off the two volcanic islands of Saint-Paul & Amsterdam and surrounding seamounts. It is able to deploy four 7.5m long canots and two 8.5m long pilothouse fishing boats ("caseyeurs"). While canots target rock lobster by setting single wooden traps in 0-70 m deep waters, caseyeurs set lines of iron traps in the deepest areas (>70m). Alongside the rock lobster targeting activity, handlines and lift nets are deployed, and vertical longlines are set targeting deep demersal fish species from the factory vessel and the small fishing units. All products are processed and frozen on the factory vessel then landed at the end of the fishing trip in the port of La Réunion Island. There are two fishing trips per season with an average duration of two months. Commercial activity is monitored by a fishery observer assisted by a scientific agent. A fishing season represents an average of 41 200 traps for 142 fishing days, and a catch of 370 tonnes of rock lobster. At the same time, scientific protocols have allowed the collection of biometry data for more than 15 000 specimens on a yearly basis.

Small-scale fisheries (SSF) typically involve numerous fishing vessels using diverse gears and techniques, heterogeneous landing areas and distribution routes, making it difficult to collect reliable and comprehensive data (Jentoft et al, 2017). The SPA fishery has many features of SSF, and therefore has to be monitored using a specific approach. All fishing catches are processed in a single factory vessel and products transit from one landings port. Fishery observers are present on all fishing trips to collect biological and statistical data and have enforcement powers to ensure compliance with regulations.

The SPA monitoring program therefore fulfills data requirements in terms of effort and catch monitoring, specific sampling and scientific protocols run with the collaboration of fishing crews. It supports research activities, science-driven management decisions and contributes to NR designation and MSC certification.

Spatial distribution and effort monitoring

Fine scale spatial information on effort is key for assessing the impact of fisheries on exploited resources and marine ecosystems. Obtaining hauling positions for canots, which represent the largest part of the fishing effort, is therefore of major importance. Whilst large-scale fishing vessels can be tracked using technology such as Vessel Monitoring Systems, this technology has limited applicability to small-scale fishing vessels due to space restrictions. The use of GPS trackers allowed us to collect fine scale estimates of fishing effort across gear types and spatial catch-per-unit-effort (CPUE). Among the SPA fishing units, factory vessel and caseyeurs were equipped with such devices.

The small canots can only support three crew members and set numerous single traps. It was chosen to use portable GPS trackers to collect spatial data. The GPS is placed in a protective box on each canot at the beginning of each fishing day. The recording interval is adjustable and set to 5 seconds. At the end of the day, the fishery observer downloaded GPS data using dedicated software which was then processed by a hauling detection algorithm. The processing allows the data to be filtered by detecting fishing “patterns” (e.g. slowing of speed). Data are cleaned manually by plotting them on a map. Based on the map, and the total number of traps set (provided by the crew), the fishery observer is able to manually remove the few remaining points that were detected but do not correspond to hauled traps. The spatial distribution of individual traps is finally uploaded in the fishery observer electronic logbook. This data flow (Figure 2) is performed on-board the factory vessel by the fishery observer on a daily basis and benefits from onboard verification (as opposed to post-treatment methods).

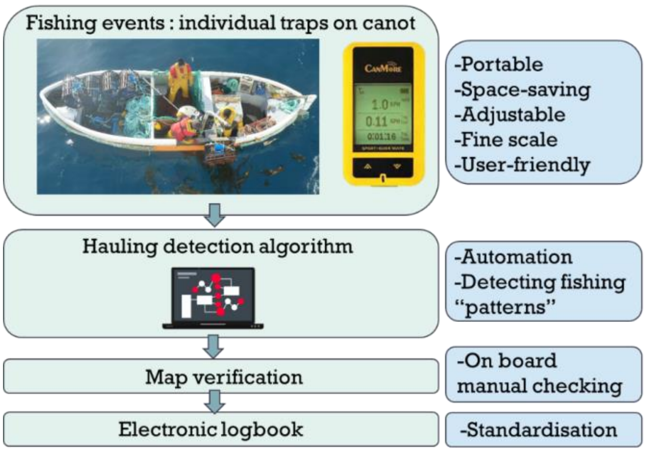

Figure 1: Description of the data flow to obtain spatial distribution of individual traps on canot by GPS tracker.

Catch monitoring (target, by-catch and discard)

Independent on-board fishery observers have been employed to monitor target catch and bycatch in some small-scale fisheries. However, monitoring SSF through fishery observers poses a major challenge given the large number of vessels causing difficulties in enforcement and hard-working conditions. In SPA, fishery observers can't get onboard all small fishing units but have the responsibility of checking fishers' declarations. Moreover, the catches come from different localities and can no longer be tracked because they are pooled together once onboard the factory ship. To obtain precise and accurate catch data (on discards, target and by-catch), a combined system across four reporting scales (Figure 2) has been developed:

1/On site discards (self-reporting)
Bycatch species discarded directly on site are reported by fishers on canots and caseyeurs using handwriting, pre-filled, waterproof PVC tablets (see Figure 2). Only weights cannot be reported.

2/Estimated delivery (self-reporting)
For fish only, the number of individuals by species, vessel and gear is collected by fishermen on PVC tablets (see Figure 2). It allows to have an accurate fish catch number with location.

3/ Force gauge delivery
At the end of fishing operations by each fishing unit, target and non-target catches are pooled and weighed by a force gauge on the factory vessel deck (see Figure 2).

4/Factory global catches
Rock lobsters and fish caught by canots and caseyeurs are transhipped and weighted to the factory vessel. Global catches, by product and fate (e.g. retained, discarded), are therefore counted and weighed on a daily basis. The only spatial specification is the island and the coastal/demersal area (see Figure 2).

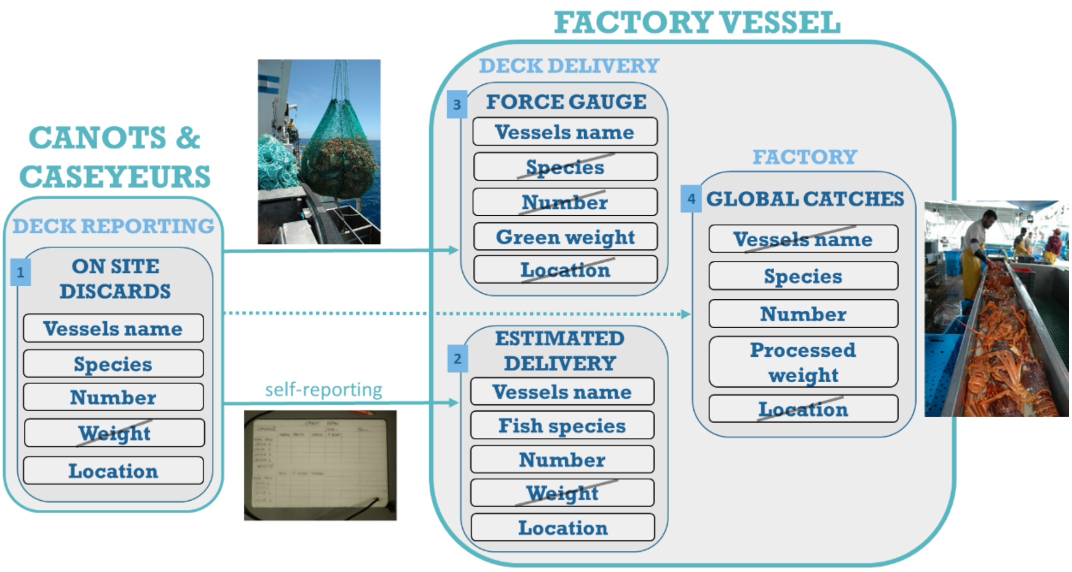

Figure 2: Schematic representation of the four catches reporting scales

All catch data are centralized in the fishery observer electronic logbook and integrated tools are provided to ensure data consistency.

Collecting biological data

The inability of fishery observers to be on board all fishing vessels to monitor fishing operations necessitated the implementation of different sampling schemes to collect biological data on length distribution, sex, maturity, tag recapture and conversion factors.

The fishermen are thus asked to bring back to the factory vessel the samples needed for the biometry data collection protocol of the fishery observer. They also self-report the detailed date, location and gear associated with the sample (termed a “biological session”). With the help of fishermen, biological samples can therefore be linked to a specific fishing operation in order to obtain fine temporal and spatial definition.

Specific scientific protocols

The observation program includes certain research activities, based on protocols designed to collect data for specific analyses. Such scientific protocols are implemented in close cooperation with fishers and conducted on board by the fishery observer and the scientific agent. This part of the program improves knowledge on the impacted ecosystems, a key factor to ensure commercial fishing sustainability and preservation of exploited species.

Selectivity and sorting of undersized rock lobster

The SPA fishery has implemented the on-board sorting of rock lobster in canots and caseyeurs for several years. Sorting operations are essential to ensure compliance with the minimum legal size and to limit fishing mortality on immature individuals. Recent scientific work has highlighted the impact on growth and reproduction of injuries inflicted during the handling of lobsters, particularly during sorting operations.

The objective of this protocol was (1) to provide the first assessments of the effects of sorting on rock lobster stocks and (2) to evaluate the costs/benefits of sorting practices. It required random sampling of lobsters after the sorting operation to assess the damage on appendages caused by on-board handling, and concluded that current handling procedures had low impacts on undersized individuals (Haddad et al. 2022).

In addition, tests of more selective fishing gear have also been conducted. The experiment consisted of a comparative fishing protocol of "control" (commonly used) and "test" traps based on the analysis of the size distribution of the rock lobsters caught and the efficiency of the traps (Ouzoulias et al. 2020)

Conclusion

The SPA observation program provides the accurate information needed to support science underlying management decisions: (1) primary data that supports the evaluation of target stocks and monitor bycatch and discards species (e.g. catch, effort and biological data); (2) data from research protocols that complement primary fishery dependent data (e.g. selectivity of fishing gears, handling of undersize rock lobsters). It applies an adaptative approach including the use of centralized tools in the electronic logbook, the training of fishery observers to conduct different scientific protocols and the close cooperation of fishermen.

The establishment of the program also emphasized the importance of collaboration between stakeholders (administration, fishing crew, scientists and data managers) to incorporate the needs of each: management, operational feasibility, data quality and interoperability.

Acknowledgments
We would like to acknowledge the Direction générale des affaires maritimes, de la pêche et de l'aquaculture du Ministère de l’Agriculture et de la Souveraineté Alimentaire and the Muséum national d’Histoire naturelle for support and funding. All the fishery observers from the TAAF administration for collecting data at sea, the shipowners and crews involved in the fisheries. Steve Kennelly for his valuable proofreading.

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Main achievements of the implementation of the discard research program in the Chilean demersal crustacean fishery

Escobar, V, C. Bernal, C. Bravo, J. Saavedra-Nievas, O. Yáñez & N. Salas

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Introduction

In Chile, a discard research program was implemented in crustacean trawl fisheries (shrimp, red squab lobster and yellow squab lobster) ten years ago. The results obtained until now, have allowed to identify the discard composition, where important commercial species (Chilean hake), other bone fishes, Chondrichthyes and crustaceans without commercial value are commonly founded. The results in these fisheries showed a progressive reduction of discards along the studied period. The main causes of discards for target species were legal and administrative problems, while non target species are discarded principally by economic reasons.

To reduce the discard in this fishery, a reduction plan of discard has been implemented since 2017. This plan and its monitoring, is oriented to progressively reduce the discard following FAO recommendation, and based in discard research program.

Methodology

The purpose of the mitigation plan discard is to establish guidelines to develop and maintain biological, ecological and socio-economically sustainable to demersal crustacean fisheries. The management approach described for the discard reduction plan consists of four components which are presented in Figure 1.

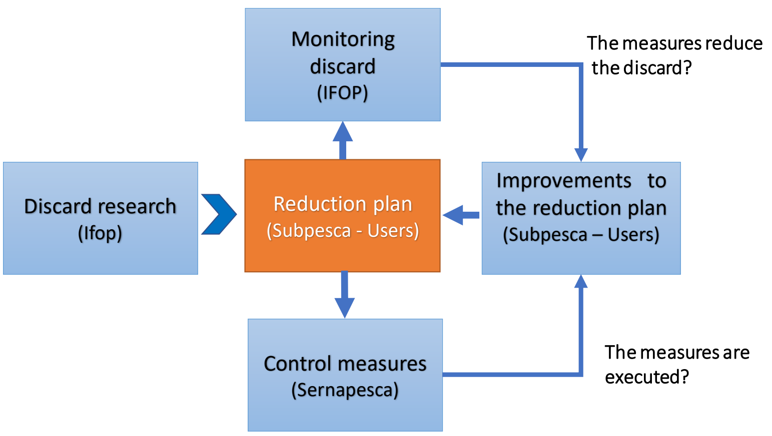

Figure 1. Conceptual model of discard reduction plan. IFOP: Fisheries Development Institute. Subpesca: Subsecretariat of Fisheries and Aquaculture. Sernapesca: National Fisheries and Aquaculture Service.

The Program is developed in demersal artisanal and industrial crustacean trawl fisheries distributed between 26°00´ and 38°30´South Latitude. The Scientific Observer role is fundamental to carried out the whole objectives in the discard research program.

The discard reduction plan for the demersal crustacean fishery introduces conservation measures, technological means, and codes of good practices, then would allow for the mitigation of discards and incidental catch. The plan established four categories specifying measures and actions for each of the following: target species, bycatch with quota or under the Tradable Fishing License (TFL) system, bycatch without quota and without current value and incidental catch.

Results and Discussion

The trend observed for the entire study period has been a decrease in discard percentages compared to the previous year in all demersal crustacean fisheries (Figure 2).

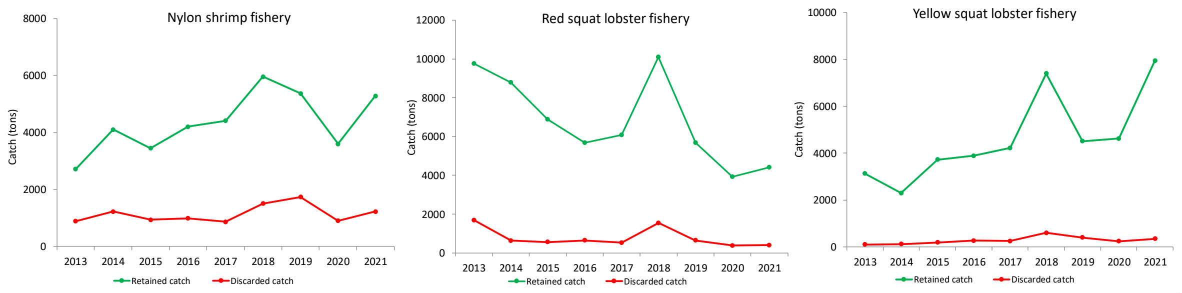

Figure 2. Retained and discarded catch in the crustacean fishery. Period 2013-2021

A high number of species are caught in these fisheries, only a few species contributing to 95% of the total weight of the catch. The species that concentrate the highest percentages of discards are the Aconcagua grenadier, Chilean hake, bigeye flounder, armed box crab and lemon rock crab (Bernal *et al*., 2022).

The main causes of discarding in these fisheries correspond to “non-commercial species”, which is related to the lack of market for the species that make up the accompanying fauna. In the case of the target species, the main causes correspond to administrative (fishing ban), operational (plant requirements) and quality reasons.

The species that in the mitigation plan have a discard prohibition, during the last year their discard percentages have decreased -among them- the Chilean hake.

Contributions regarding fishing biological indicators of the target species, bycatch and incidental capture for the certification program of the crustacean fishery of the Marine Stewardship Council (MSC).

Relevant information for the installation of a monitoring system with discard cameras in the crustacean fishing operation in accordance with the Chilean fishing law.

Incorporations of discard estimates into the stock assessment of crustacean fisheries.

The discards research program implemented by IFOP has faced a great challenge, however the development of an adequate and standardized program has become a reality thanks to the scientific observer hard work and to the support of fishers and fishing companies.

Increase fishing selectivity through technological improvements of fishing gear (Queirolo *et al*., 2018) and through reductions in discards through a better regulatory framework and more effective surveillance with the recent incorporation of cameras on board, the information generated by the research program Discard management will enable the implementation of effective mitigation measures agreed by all stakeholders and supported by enhanced and permanent monitoring through the on-board deployment of scientific observers.

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Abstracts of poster presentations that did not provide Extended Abstracts

Bringing together a Scientific project and a Fisheries observer program to monitor sea turtles in the North Atlantic

Miguel Machete

Institute of Marine Research, Portugal

Monitoring and data collection for oceanic, widely distributed and highly migratory species is a well-recognized challenge for conservation and environmental management. This is the case for long-lived species such as sea turtles that have complex lifecycles that span distinct environments in different phases of their live, such as coastal areas, nesting beaches, and the open ocean. The open ocean in particular, due to its dimension, patchiness and low density, has been identified as a priority environment for the development of monitoring strategies for sea turtles in the framework of environmental policies and conventions. In Europe, the MSFD, as well Regional Seas Conventions such as the OSPAR and Barcelona Conventions, impose high data requirements on member states in order to assess the status of the marine environment. The Azores Fisheries Observer Program (POPA) has collected data on main Azorean commercial fisheries and associated macrofauna species since 1998 with special emphasis on pole and line tuna fishery. Since 2015, the COSTA project (COnsolidating Sea Turtle conservation in the Azores) ensures the conservation of sea turtles in the Azores and their oceanic habitat in the North Atlantic through monitoring, research, environmental education, technical training and support for decision-making. Here we present how POPA and the COSTA project, join efforts to deal with the challenge mentioned above through the adoption of a diversified monitoring strategy for loggerhead sea turtles, resulting in the program being a major provider of data for the species in the North-East Atlantic. These include long-term abundance estimates from standardized visual census onboard the pole-and-line tuna fleet and bycatch and mortality estimates from the surface longline fleet, complemented with accessory data from conventional tagging. Simultaneously, the observer program assists the COSTA project to reach its conservation objectives through the promotion and implementation of best handling practices in the pelagic longline fleet.

How Observer Data Support Humpback Whale Conservation

Kevin Stockmann

Alaskan Observers Inc, United States

We closely monitor fishing interactions with protected species to ensure that fishing effort does not push these animals further towards extinction and to contribute to the science of their long-term conservation. In NOAA's West Coast Groundfish Observer Program (WCGOP) a top priority for observers is documenting fishing vessel interactions with species legally protected under the United States Endangered Species Act.

The humpback whale (Megaptera novaeangliae) occurs in all oceans of the world. Of the fourteen distinct population segments, four are listed as endangered and one is listed as threatened. The range of the endangered Central America humpback population and the threatened Mexico humpback population overlap with commercial West Coast fishing effort. Fishery gear entanglements are a documented source of humpback whale mortality and have increased sharply in recent years along the United States West Coast waters (Saez et al., 2021). WCGOP observers have twice documented entanglements of humpback whales in sablefish pot gear. (Jannot et al., 2022)

I will present how observer data provide the basis for predicting total annual number, and associated uncertainty, of fleet-wide sablefish pot gear entanglements. In 2020, NMFS issued a biological opinion concluding that continued operation of the West Coast groundfish fisheries is likely to adversely affect, but not likely to jeopardize, the continued existence of both protected humpback populations. This presentation will illustrate how observer data was used in this biological opinion and how WCGOP observer coverage maintains the capability to provide scientifically defensible humpback whale bycatch estimates.

I will explore additional observer data collection ideas that could provide better characterization of pot fishery gear configurations, and the potential for modified gear configurations to reduce whale entanglements. I will review general whale entanglement trends along the U.S. West Coast and present how opportunistically collected confirmed entanglement reports can contribute to humpback whale conservation.

Brown Box Crab Experimental Fishery in Southern California and The Tuna Harbor Dockside Market

Steven Todd

Alaskan Observers Inc. United States

Brown Box Crab (Lopholithodes foraminatus) are a new experimental commercial fishery in Southern California. A fishery managed by the California Department of Fish and Wildlife (CDFW), observer coverage and biological data recording began internally with success, but greater fleet coverage and trip data were needed. To satisfy their program goals and reduce costs, an interagency approach was negotiated to include the West Coast Groundfish Observer Program (WCGOP), the Pacific States Marine Fisheries Commission, and Alaskan Observers Inc. Highly trained and experienced WCGOP observers were integrated by CDFW late in 2019 to bolster data collection. The WCGOP program already had observers stationed strategically coastwide, and in the active ports for this fishery, which greatly facilitated observer availability and fleet access.

This new fishery has incorporated a fresh approach to management: data-forward strategies that are used to determine fishery viability and future access to the resource utilize both remote video monitoring and WCGOP observers for shipboard collection. Population dynamics, catch density, area productivity, fishery by-catch, and discard are documented and recorded with a robust sampling protocol.

The reasons why and what we manage in fisheries are numerous, but hinge on the essential characteristics of taste, abundance, and market value. Brown Box Crab historically were an ancillary and novelty catch with low annual landings. Identified for their culinary and market potential by select fisherman, landings increased significantly in 2014, capturing the attention of CDFW, and the patrons of the newly inaugurated Tuna Harbor Dockside Market (THDM) in San Diego. Popularity and demand for Brown Box Crab, along with other local, traceable seafood continues to grow at the THDM. Early monitoring of catch and effort will significantly aid in proper management, determine harvest guidelines, and promote future sustainable harvest.

Session 2. Industry engagement with monitoring

Leader: Jennifer Ferdinand

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

Oral Presentations - Extended Abstracts

Industry involvement - the journey from ceasefire to establishment of collaboration committee, fisher-scientist projects and fishing industry actively engaged in data collection

Kenn Skau Fischer[1*] and Jørgen Dalskov[2]

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[2]National Institute for Aquatic resources (DTU Aqua), Technical University of Denmark.

***Corresponding author**

Introduction

The fishing sector of Denmark is the second largest in the European Union (EU), targeting a wide number of regulated demersal, pelagic and shellfish stocks fished for human consumption purposes and some stocks for fish meal- and oil production.

The fishery in the EU is managed through the European common fisheries policy (CFP). As other EU fishing Member States (MS) Denmark is obliged to carry out an extensive fishery dependent and fishery independent data collection for supporting the management of the CFP and for providing basic data for the stock assessment and scientific advice work. The setting of fishing possibilities in the CFP is based on the scientific advice provided by the International Council for the Exploration of the Sea (ICES). Denmark is one of the ICES member countries and is heavily involved in the advisory work from carrying out stock assessment to the scientific advice.

If the scientific advice on the fish stocks and stock developments leads to a political decision on the fishing possibilities that differs significantly from the fisher's perspective, or advice on other management rules that implicates catch limitations to the industry, it is inevitable that it can lead to discontentedness and unwillingness for fishers to cooperate with the [national] fisheries scientists and especially the fishery dependent data collection.

This was indeed a challenge for the Danish fisheries and the fisheries scientists in the first decade of this century. Collaboration and trust between the two communities was poor and to some degree limited to individual relationships.

What did we do?

The leaderships of the Danish Fishers Producers Organisation (DFPO) and the National Institute for Aquatic resources (DTU Aqua) realized that better and open-minded dialogue between fishers and scientists and a formalized cooperation was necessary. And not just at leadership level – scientist and fishers had to get to know each other and each other's communities.

It was agreed to establish a collaboration committee including representatives from DFPO and DTU Aqua. Terms of reference for the committee was discussed thoroughly and signed by the two leaderships. The following issues were to be handled by the committee: Data collection coordination and data quality control; data self-sampling programmes; scientific at sea observer programmes; gear trials with the aim of development of more selective gears; fish tagging programmes and other tasks where collaboration could be to the benefit for the outcome.

In addition to the collaboration committee, a Fisher-Scientist-Network [in Danish: "fisker-forsker-netværk"] was established at national level with the aim of improving the open-minded dialogue and cooperating about developing and carrying out scientific collaboration projects and other activities. The Network includes DTU Aqua, DFPO and the Danish Pelagic Producer Organisation (DPPO) that was included in the collaboration programme a couple of years after the establishment. The work carried out by the network was financially supported the Danish Ministry for Food, Agriculture and Fisheries in cooperation with the European Maritime and Fisheries Fund.

The activities Fisher/Scientist network includes e.g. teaching of fisher school students at Thyboroen School for Fishers, learning scientists and academics about the fishing life, methods and business, conduct "after work" seminars at local fishers associations, coordinate dissemination of relevant information to the industry and other relevant parties from scientists and vice versa, improve selectivity in fisheries through knowledge-sharing between fishers, scientists and others like gear and trawl producers, initiate project applications and other initiatives that promote and support collaboration between the fishing industry and the scientists.

The aim of these activities was to build trust between fishers and scientist, facilitate open-minded information exchange and educate young fishers and scientists on sustainable use of the living marine resources.

Data collection

The Danish fishing fleet consist of more than 2000 vessel where app. 700 are commercially active. The Danish fishery can be grouped into four different fisheries; demersal fishery targeting demersal species such as Nephrops (Norway lobster) cod, plaice, shrimps, haddock, saithe for human consumption; mussels and other shellfish for human consumption; pelagic fishery targeting pelagic species such as herring and mackerel and; a fishery targeting short lived species such as sandeel, sprat, blue whiting and Norway Pout for fish meal and oil production. The total landing varies between 450,000 tonnes and 750,000 tonnes annually, depending especially on the fishing possibilities of sandeel and sprat.

The EU control regulation sets out the principals for official recording and reporting of e.g. logbooks, Vessel Monitoring System (VMS) transmissions and landing declaration and all first-hand sale where per species weight, value and quality has to be reported to the national competent authority.

The EU Data Collection Framework Regulation sets out the basic principles and the general rules on the collection, management and use of data, in line with the CFP. According to this legislation MS are obliged to establish two scientific data collection programmes; a fishery independent data collection programme and a fishery depending programme where the later programme consist of three types of data collection: 1. An at sea observer programme, 2. A sampling of landings in harbours and 3. A self-sampling programme.

In order to ensure common understanding, transparency, co-responsibility and quality insurance of collected data DFPO and DTU Aqua established a fisheries dependent data collection committee. This committee is responsible for planning and quality ensurance of the data collection.

Since the establishment of this committee the Danish fisheries data collection has improved significantly. Fishers are not obliged to take observers onboard. Therefore, it is a challenge encouraging fishers to take observers onboard. Significant improvements have been made over the years but there is still room for improvement. Even though the leadership of the DFPO again and again promotes the need for collaboration with the scientists and thereby observers as part of the data collection, some fishers are still reluctant taking observers onboard, [still] not trusting that this is of mutual interest.

Running a self-sampling programme where fishers collect samples onboard, store these sampled for later to be handed over to the scientists requires a huge effort because regularly contact between the fishers and the scientists is a prerequisite for running such a data collection programme. Logistics are also something in this respect that should not be underestimated - how to keep the sampling, where to deliver the samplings, how to pick up the samplings, what to do with the samplings etc. Representatives from DFPO and DPPO have shown to be very important players as they act as “breakwaters” between the fishers and the scientists.

<u>Results, lesson learned and challenges</u>

Before establishing formalised collaboration on data collection the data used a basis input data for the stock assessment of all the regulated commercial stocks in the North East Atlantic area with a Danish interest were often questioned by the fishing sector for not showing the actual trend. This has changed – and though we still see challenges, both scientists and fishers value the mutual interest in constantly improving the data.

In fact, today many in the fishing sector finds that that the data collection process and the setting of fishing possibilities can be improved even further using the data that fishers collect and are able to collect spending much more time at sea than anyone else.

Trust is necessary for an open and constructive collaboration. Trust is not built just on setting up a committee at leadership level. Both parties must at vessel, fishing harbor, laboratory or at classroom level through experience learn the benefits from collaboration on the data collection etc.

Trust among fishers and scientists has improved significantly in Denmark over the last decade – and not just at leadership level. And though there is still room for improvements regarding the observer programme and the scientists understanding of the fisheries both parties today benefit from the open dialog which has led into cooperation also on other aspects within fisheries science, fishing gear development and fisheries management.

In addition to the data collection projects DTU Aqua and DFPO and/or DPPO over the latest 5-10 years together have been running 5-15 projects annually. These projects are aiming development of more selective mobile demersal gears, improvement of the understanding structures of specific stocks, more sustainable fisheries management, more intelligent fishing using technological tools, development of new fisheries and in general development of more sustainable use of the marine living resources.

In fact, a challenge to the collaboration between fishers and scientist today is the constructive dialogue. The collaboration is sometimes met with scepticism or even distrust from politicians, authorities, other universities and eNGOs. They are concerned about how the fishers might influence the scientific work or wants to part of the collaboration. In both cases, the result can be a pressure to involve more organisations in the collaboration inevitably reduces the ownership to anyone in the cooperate programme and especially the fishing sectors willingness to engage in the collaboration.

20 years of industry/science collaboration in Southern California, USA

Jim Benante

Pacific States Marine Fisheries Commission (PSMFC)

In Southern California a unique and effective project has reaped the benefits of pairing scientists and fishermen together to fill important data gaps, assist with decreasing uncertainty in stock assessments and to pursue a variety of other research goals. The Southern California Shelf Rockfish Survey has a time series going back to 2004 and is an important data set that has been used in 18 groundfish stock assessments for ten different species on the West Coast of the United States and has led to several other important research endeavors. The survey was developed with the help of two former fisheries observers and with early and substantial contributions from industry.

As part of this effort, three commercial sport fishing vessels are transformed into research vessels where scientists work side by side with fishermen to collect data and samples. The captain for each of the three vessels have over 35 years' experience each. Two of the current captains have participated in this survey for the past 20 years. These long-standing relationships have created strong relationships and collaborations that have collected data directly used by fisheries managers and advanced a variety of other research projects. Fisheries observers have a unique skill set that is conducive to this type of cooperative research. This experience was a great asset in developing long standing and effective partnerships with industry despite a history of misunderstanding and mistrust between the groups.

The survey has allowed for many innovative approaches to be tested and implemented to support survey operations as well as father fisheries research projects including DNA tag recapture techniques via biopsy hooks, eDNA comparisons to actual catches, oceanographic data collection, paperless data collection via a wireless network at sea, cryptic species studies, etc. Survey data has become helpful in 18 different stock assessments for 10 different species, several of which an annual index of relative abundance has been developed.

These relationships will hopefully foster future cooperative efforts that will help scientists and fishermen to explore new and innovative approaches to assisting with the process of managing groundfish stocks. The Southern California Shelf Rockfish Survey will be used to highlight the benefits of cooperative research efforts and how prior observer experience was an asset to the development of this collaboration and how observers are uniquely qualified to form and maintain these relationships.

For more information please use these QR codes to view videos highlighting the collaborative research conducted on this survey.

Below are links for further information about cooperative research and the Southern California Shelf Rockfish Hook and Line Survey.

Reeling to Rebuilding: Success for West Coast Groundfish Fisheries

Reflections on the West Coast Groundfish Surveys

A commercial fishermen's perspective on getting involved in fisheries management

Southern California Hook and Line Shelf Rockfish Survey

Below are QR codes for the links above.

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Collaboration in the Spencer Gulf Prawn Fishery between Government and Industry – working together to secure a sustained fishery into the future.

Graham Hooper

South Australian Research And Development Institute, Australia

The provision of concise scientific advice on the status of South Australian Crustacean fisheries such as Prawns, Blue Crabs and Lobsters, is dependent on the collection of robust fishery-dependent and fishery-independent data. The collection of independent data for the Spencer Gulf Prawn fishery via surveys using industry vessels is recognized as an integral component in this process.

These surveys are designed to inform a harvest strategy that explicitly links a weighted mean catch rate for adult prawns to a stock status classification (either “sustainable”, “transitional” or “depleted”). The determination of the stock status drives a set of decision rules and criteria that are then applicable in the following fishing season. This information allows for reliable planning between stakeholders for harvesting prawns in the future.

Prior to every fishing season, there are three key events involving Government and Industry:

1. Observer workshops
2. Skippers Meetings
3. Fishery-independent stock assessment surveys conducted around November, March and April of each fishing-year (October thru to June).

Typically, a survey plan involves up to ten commercial prawn trawlers with independent observers onboard each vessel. Data collected during fishery-independent surveys include prawn catch rate, sex ratio size-frequency, bucket counts of prawns, commercial size grading, as well as bycatch monitoring work to inform Marine Stewardship Certification requirements.

Data are collected at approximately 200 trawl shot locations of 30-minute trawl duration and are entered into E-logs for analysis generating the fishing strategy for upcoming fishing run. Importantly this collection is undertaken in real time so that fishing can commence immediately after a survey. If criteria are not met, then fishing grounds are kept closed in certain areas of the fishery until a new survey has been undertaken.

This collaboration has led to a stock status for the Spencer Gulf Prawn Fishery remaining as “sustainable” for almost 20 years.

Voluntary implementation of 100% documented pelagic fisheries in the Northeast Atlantic

Claus R. Sparrevohn, Lise Laustsen, Esben Sverdrup

Danish Pelagic, Denmark

As the first of the major fleets operating in the Northeast Atlantic, Danish pelagic fishermen organized in the Danish Pelagic Producer Organisation (DPPO) will in 2023 voluntarily install CCTV and associated sensors onboard their vessels. With this decision, close to 100% of all Danish mackerel, blue whiting and herring catches will monitored and 50-75% of all Danish sandeel, sprat and Norway pout catches. There are at present 11 trawlers/purse seiners organized by DPPO, all of them being fresh fish vessel with refrigerated seawater (RSW) tanks. The vessels are ranging from 50 to 93 m in total length and has a holding capacity between 1000 and 3000 tonnes.

The transparent monitoring system, records and stores all relevant fisheries-related data from the vessels, including video from CCTV surveillance and sensor data logging. All data and information from the fishing operations are made directly available to the Danish fisheries authorities and other relevant public and private partners.

In this presentation we will give an insight into concerns and discussion raised internally within the fishery organization prior to the decision of implementing a documented fishery with full access for relevant authorities. Further we will describe the practical setup of the surveillance where focus for CCTV has been on the stern of the vessel, the fish/water separator and sampling station. CCTV camera recordings in combination with logging of sensor data such as the temperature in the fish holding tanks, pumping and winch activity is believed to provide an appropriate description of the fish catch, pumping and handling onboard the vessel.

The Oceanic Fish Restoration Project- Successful Monitoring Achieved Through Industry Collaboration

Matthew Walia

National Oceanic and Atmospheric Administration, United States

The Oceanic Fish Restoration Project (OFRP) was initiated to evaluate the impact to finfish populations by the 2010 Deepwater Horizon oil spill within the United States. Industry “buy-in” is essential when implementing a new fishery monitoring program, such as the OFRP, but input and expertise from industry are not always included in project development. Project success, in this case, was highly influenced by a close collaboration among commercial pelagic longliners, federal government fishery managers, fishery observers, a non-governmental organization (National Fish and Wildlife Foundation, NFWF), and community liaisons directly from industry. The community liaisons were integral in providing local fishing knowledge and techniques to project managers and conveying government needs and compliance concerns back to the participants throughout the project. Active industry participation and feedback allowed for rapid changes to legal fishery techniques. From 2017 through 2022, 19 unique vessel owners in the Gulf of Mexico were compensated for using alternative gear (i.e., buoy gear, greenstick, and deep-drop reels) instead of longlines for the first 6 months of each year to catch pelagic species, such as swordfish and yellowfin tuna. Reductions in bycatch and discards within the fishery and industry support of the use of alternative fishing gear for pelagic fish species were successful outcomes of the OFRP. Novel approaches to outreach by industry volunteers and community liaisons, coupled with adaptive management, including gear testing, by National Oceanic Atmospheric Administration Fisheries and NFWF were essential elements that allowed for this success. This industry-led restoration project provides a path for future generations of fishers to continue harvesting in a sustainable way. The overall approach to project design, including implementing community liaisons, are applicable to other small scale fisheries and has potential to be applied in other regions.

Catch Monitoring and Control Plan: A collaborative tool used by industry and agency to collect accurate landing data, and improve observer data quality

Melanie Rickett

National Oceanic and Atmospheric Administration, United States

A Catch Monitoring and Control Plan (CMCP) is a tool used by both the industry and the agency that details how a shoreside processing plants can monitor and account for all catch that is landed while meeting any federal regulation requirements. The CMCP acts as a road map for the observers and crew working at the shoreside processors in that the CMCP provides information on communication methods, descriptions and diagrams for flow of fish through the plant, and designated sorting and sampling areas. The details contained within the CMCP help industry and observers report the most accurate and near real time data for inseason management. CMCP's have been used by Alaska fisheries management for more than a decade to account for salmon bycatch and to collect accurate rockfish landings. With the introduction of some electronic monitoring systems on vessels, these flexible tools have become even more important as observer sampling moves shoreside. These plans are instrumental in not only tracking landings, but in assisting observers to collect reliable data at the shoreside processors.

The industry must review the catch monitoring regulations and prepare a written draft describing how they will track and account for all fish landed, as well as discuss the tools will be used to communicate with the observer as well as outline how the plant will work with the observer to accommodate adequate data collecting. Plant managers or owners will write up a CMCP and submitted to it the agency for review. The Agency and the industry will then work together to review and understand the submitted CMCP to insure that it meets the needs of all parties involved prior to the documents approval (observer, plant personal, data managers, and agency regulators).

Open Discussion Session

Unidentified to Graham Hooper
Q: Who pays for surveys?
A. 39 fishermen, money from fish licenses/permits

Unidentified to Matthew Walia
Q: Where do you find community liaison people?
A: We receive recommendations from the fishing fleet, community outreach, and people that were previously involved.

Dave Colpo to Claus Reedtz Sparrevohn
Q: Are the 11 vessels managed as one entity or separately?
A. The vessels are managed separately.

Dave Colpo to Claus Reedtz Sparrevohn
Q: If the government requests video footage what is the common reason for that request?
A. Many reasons among the different companies and boats

Victor Ngcongo to panel
Q.: With working with the fishing industry, a big issue is collecting data on non-target species. How do you get fishermen to provide you with that information on their logbooks?
A: Develop trust and get fishers to engage in things like projects to make fishing gears more selective.
Fishermen do not want to admit to catching things that they are not allowed to because they think it will negatively affect them moving forward. To combat this we need to make it beneficial for them to tell the truth and accurately report the bycatch, or at least make it so that it does not negatively affect them.
We must instill/make them trust that the data collected is useful and important.
Make the data available and useful to the fishermen and they will be more willing.
There is an interaction report you have to fill in in Australia, but still have to do independent reports that match the survey reports.
One message is that the more accurate the data, the more access the fisheries have to the stock.

Carolina Breakell to Kenn Skau Fischer and Klaus Reeddtz Sparrevohn
Q: What steps can be taken to foster mutual trust when the fishery is in trouble?
A: Don’t just talk to them about the fisheries, tell them how to talk to media, while building a relationship to a degree. Also, listen to their opinions and ask them what they think the best method of moving forward is. It is also important to inform fishers that the stock information isn’t just coming from a faraway place and that the observers are not at fault for the stock results of a stock assessment; they are collecting data that tells the story.
Took a group of fisherman and scientists and play roles in this subject, build relationship and cooperation, friendly chats not just about fisheries. Building relationships is the best solution. Through discussions with industry members, researchers gain an understanding of what the fishers need and approaches that can benefit them. Observers are not to be seen as the enemy, and partnerships help the fishermen gain mutual benefit from the science.

Phil Bear to Graham Hooper
Q: What factors determine what fish get included?
A. Species that are very important including endangered species. Systems are in place on boats to get bycatch back in the water fast

Phil Ganz to Claus Reedtz Sparrevohn
Q: When 100% documentation was implemented did you consider going back to less and how did you make those decisions?
A. We are in the process of implementing 100 percent and trying to address all 11 vessels with some sort of electronic monitoring. Not 100 percent yet. That is, data were always being recorded but not always reviewed, the level of which is determined by authorities.

Miguel Machete to Kenn Skau Fischer, Claus Reedtz Sparrevohn, and Matthew Walia
Q: How do you deal with the pressure to maintain trust with fishers?
A: (From Skau Fischer and Claus Reedtz Sparrevohn): We are Danish! The meetings between scientists and fisherman generally go well but there can be tension, sometimes they have to have repeating meetings depending on the atmosphere. Can be tense, but normally can be resolved if you have a will to be a leader and come together with a compromise, must be willing to try. Dialogue is key. Bring something for the meetings. Don't come empty handed. Be willing to invest in the case from both sides.
From Matthew Walia: Find something neutral to talk about. We have witnessed conflict, but it takes time to resolve issues but they can be resolved. Education programs promote fishermen to come, then they can become advocates and talk to other fisherman about benefits from communication.

Isaac Forster to Matthew Walia
Q: What motivated fishers to try the new gear type?
A. They're given money to offset their costs and can keep the gear after the survey. This gear also requires less crew so captains/stakeholders can save money. (Positive cost/benefit)

Ken Keen to Matthew Walia
Q: Will they keep using that gear?
A. Yes, however time will tell because the dealers want more fish and this gear isn't providing that desired number.

Craig Faunce to Claus Reedtz Sparrevohn
Q: Have you thought about monetizing observer data?
A. Useful data is already there. Collecting acoustics or VMS data as real time monitoring is a priority but not charged for as yet.

Unidentified to Kenn Skau Fischer
Q: What is the largest EU fishing country?
A. Spain. Norway and Iceland are not part of the EU. They set TACs for different stocks.

Macdara O Cuaig to panel

Q: How do you manage both sides' expectations towards data that can be collected?
A. Fishers involved in science expect to be allowed to harvest more fish. Scientists expect to collect more data.
Involve stock assessment people, certified independent experts invite fishers to come to that process.
Patience. Go to the fish houses/dealers and show them why the data is collected.
Fishers don't like surprises; transparency works best. Engage them in processes, keep them at the table.
When we were designing a survey and asked the industry where to catch fish they lied because they didn't want science to know. 40% of the sites caught nothing because of this. 6 years later different fishers came to the table and were more responsive to participating in science. As fishers see the benefits of science/data collection they are more likely to participate. Things change over time.

Unidentified to Graham Hooper.
Q: Is there a decent survival rate using the hopper?
A. Decent when hopper is used correctly. Not 100% survival but very good, other species hard to mitigate survival rate due to the gear used.

Q: Is there a possibility of implementing the hopper system in the southeast USA?
A. It's possible but a long process, a lot of opposition and it might take some time but could be a good suggestion.

Session 3. Operationalising technology-based monitoring: Learning from programmes around the world

Leader Mark Michelin

Electronic Monitoring (EM) and Electronic Reporting (ER) technology have been around for over two decades and many agencies responsible for fishery monitoring are eager to learn from the experiences of those who are operationalizing these tools in their monitoring programs.

Issues such as program objectives, equipment choices, deployment and maintenance of gear, wireless data transmission, using machine learning for more efficient video review, data accuracy, funding models, and determining appropriate review rates were examined in an attempt to identify "best-practices" and key challenges to integrating technology into monitoring programs.

Oral Presentations - Extended Abstracts

Australia's perspectives on the benefits of Electronic Monitoring – compliance and enforcement programs

Rebecca Darcy

Australian Fisheries Management Authority

The Australian Fisheries Management Authority (AFMA) implemented electronic monitoring (EM) in 2015 to provide fisheries management with a robust independent data collection tool. The EM data, which can include video, sensor, and/or geolocation data, is used to audit and verify fisher's logbooks to improve fishery dependent data. The AFMA has now mandated the use of EM in ~ 75 vessels within the Eastern Tuna and Billfish Fishery (ETBF), Western Billfish Fishery (WTBF), Gillnet, Hook and Trap Fishery (GHATF) and Small Pelagic Fishery (SPF). During this time, the EM program has demonstrated that there are several benefits the EM tool can provide. One benefit, that is rarely mentioned in documentation and discussion previously, is how EM has enhanced compliance and enforcement programs.

Compliance and enforcement play a key role in allowing AFMA's EM program to improve fishery dependent data for fisheries management. Data collected using the EM tool is used to verify and audit fisher logbook data. If significant discrepancies are identified between the EM and logbook data sets, they are then referred to compliance and enforcement teams in AFMA that use education or enforcement actions to facilitate the behavioural change of fishers, resulting in more accurate reporting of fishing activities. This process ensures the accuracy of data needed for threatened, endangered, and protected species management, stock assessments, and ecosystem impacts, thus increasing confidence in management decision making (see figure 1).

Figure 1. Key components and processes that allow the electronic monitoring (EM) program to improve fishery dependant data, and therefore, increase confidence of fisheries management decisions.

Over the past eight years of having an operational EM program AFMA has identified that the EM tool can provide several benefits to compliance and enforcement programs, including:

- Strengthen briefs of evidence – EM video can strengthen court cases and evidence briefs as it provides an independent source of information and cannot be subjected to bribes, threats or coercion.
- EM video is not usually contested – because video evidence is independent, fishers usually do not contest the video footage which reduces the need to pursue convictions through court and therefore reduces resources required by compliance.
- Deters non-compliance – the presence of cameras deters fishers from committing an offence as they know they are being monitored and will be held accountable for their actions.
- Used for education purposes – skippers and fisheries officers can use EM video footage to educate their staff on processes and practices undertaken on the vessel.
- Enhances vessel risk profiling – EM supports AFMA's risk-based compliance program by identifying non-compliance at a vessel level and enables resources to be focused on serial offenders.
- Support or verify other data collection methods – EM video, sensor and geolocation can verify or support other data collection tools utilised in compliance desktop assessments (see example of Vessel Monitoring System (VMS) data aligning with EM in figure 2).

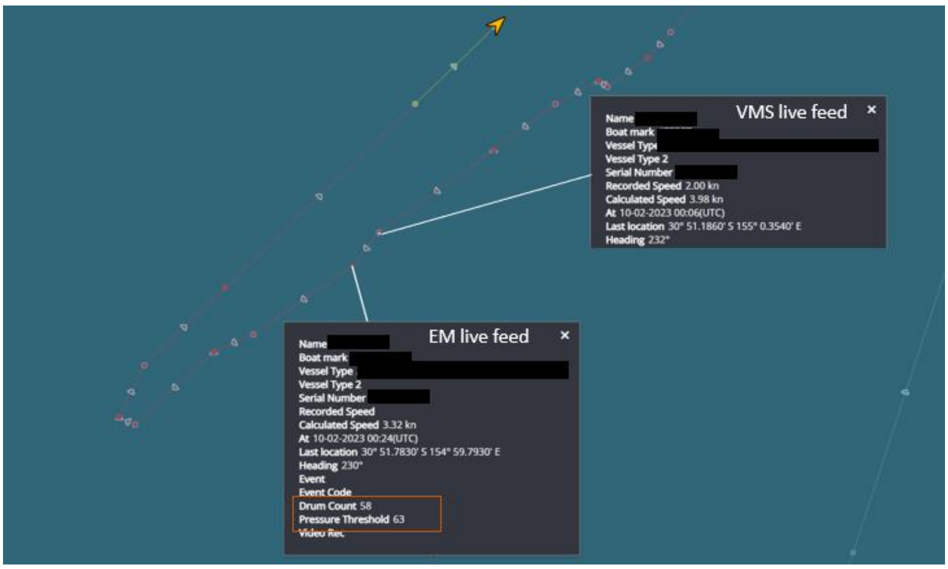

Figure 2. Vessel monitoring system (VMS) and electronic monitoring (EM) live feed position data aligning with one another in Trackwell. The EM live feed can also display the number of drum rotations and use of hydraulics by the vessel in real time.

Aside from verifying fisherman logbooks and compliance with fishery regulations, EM has also shown to capture other non-fisheries related activities. Such activities that have been identified throughout the AFMA EM program include marine pollution, Illegal use of firearms, drug use and trafficking, violence and assault (see figure 2). Many of these offences would not have been previously identified due to the limited coverage of observers. With EM's ability to provide continuous coverage across fisheries, these offences, although rare, can now be identified and passed onto the appropriate authorities for a response.

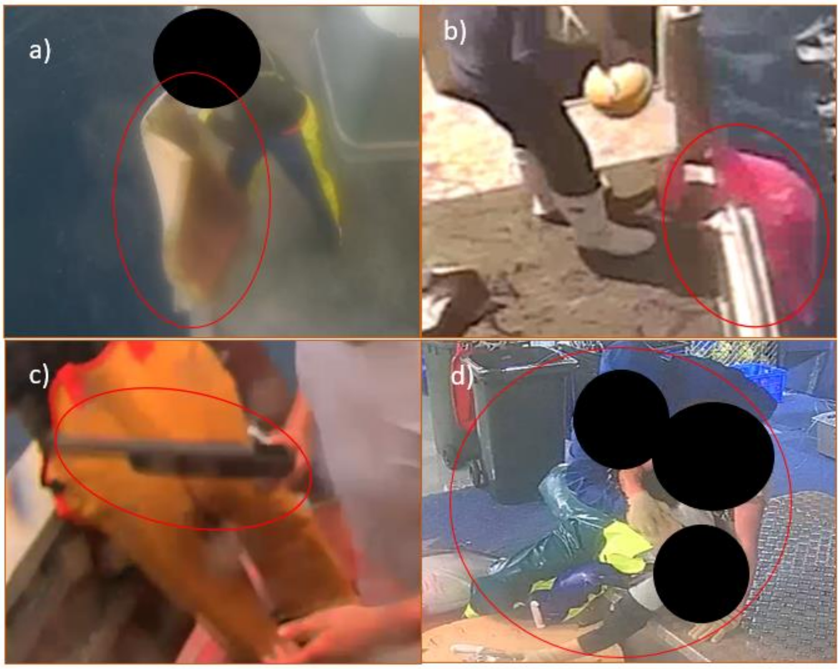

Figure 2. Non-fisheries related offences identified by electronic monitoring (EM). Activity identified in images include marine pollution (a), a suspicious package attached to a buoy (b), a firearm (c), and assault (d).

The AFMA has found that the presence of cameras initially improved compliant behaviour from fishers, similar to the observer effect. However, it is believed that this behaviour can revert to being non-compliant overtime when cameras are established. Unlike human observers, cameras have limitations that crew can use to cover up offences (e.g., obstructing the view from the camera) and their presence onboard is more easily forgotten about. For this reason, AFMA believes that the EM camera effect can wear off over time resulting in fishers reverting to non-complaint behaviour. To ensure that compliance has its greatest effect AFMA reminds fishers that their behaviour is being monitored by sending out monthly vessel feedback forms, compliance officers deliver education programs and remind skippers to re-educate their staff, and when non-compliance is detected, enforcement action is carried out promptly. Identifying and understanding camera limitations has also allowed AFMA to adapt and minimize their effect, thus reducing the chances of opportunistic behavior from fishers. Not all camera limitations from EM can be minimalized however and these need to be accepted when developing and designing EM programs.

Since the implementation of EM, AFMA has been required to amend regulations and fishing conditions to support the use of the EM tool. A key example has been the identification of animal bycatch mistreatment which was previously not known before cameras were placed on vessels. This required AFMA to implement conditions on fishers to take all reasonable steps to return bycatch back to the ocean in a timely and unharmed manner, to increase the chances of survival. With the support of an education campaign, bycatch mishandling reports reduced by approximately three-fold after the implementation of the bycatch handling condition (figure 3).

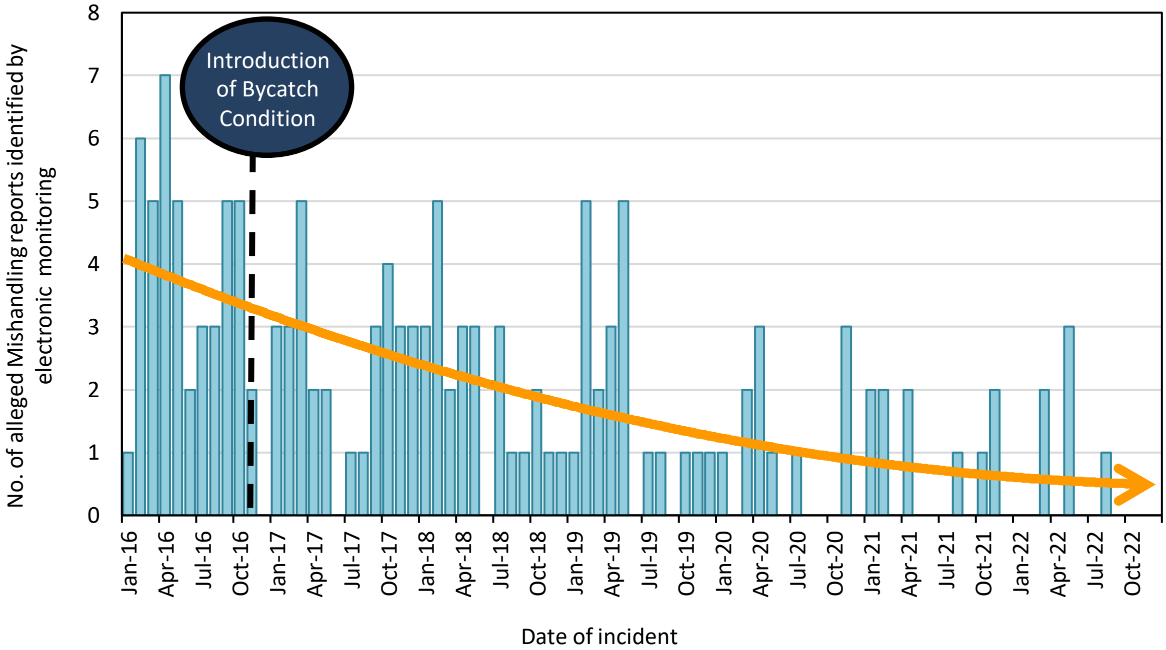

Figure 3. Number of alleged mishandling of bycatch reports identified through the electronic monitoring (EM) program since January 2016. Mishandling of bycatch may include kicking, impaling or leaving catch on deck for extended periods of time. The Australian fisheries Management Authority (AFMA) introduced a bycatch condition in October 2016.

The introduction of the EM tool and the use of it by compliance has also altered the workforce, both in the number and skillset of staff required. In AFMA, compliance and enforcement workload has increased ~750 hours a year, or half a fulltime position, for reviewing and actioning EM untoward behaviour reports for a 75-vessel program. The EM program has also increased the amount of technical support required to move, store, and maintain EM data, created new jobs in reviewing EM video footage, as well as changed the nature of at-sea observer positions to focus on biological data collection in ports rather than at sea.

AFMA has identified that the EM tool can not only support fishery management data but can also largely benefit compliance and enforcement programs to support fisheries management. To ensure the EM tool has its greatest impact it will need to be supported with educational programs, enforcement actions and regulations and legislation.

Considerations around staff roles, skillsets, work processes and EM limitations will also be needed when designing and implementing an EM program to accommodate the change to the workforce that it can bring.

Operationalizing Wireless Electronic Monitoring

Joshua Wiersma

Integrated Monitoring Inc.

Introduction

Traditionally, electronic monitoring (EM) programs have relied on hard drives, physical sensors, and shoreside servers to collect, transfer and store video and meta data. These methods were appropriate for the technology at the time and the small size of pilot projects. But, as regulators and supply chains are increasingly demanding EM programs to scale globally, with multiple jurisdictions requiring access to the data—transferring information via physical medium is not feasible, secure, or cost effective.

Instead, wireless video transfer using 4G and 5G networks, along with new high bandwidth satellite options[1] is more cost effective than traditional methods and is increasingly the preferred approach of regulators and supply chain partners around the world. These technologies are driving the 'fourth industrial revolution'--innovations are now faster, more efficient, and more widely accessible than ever; and we are seeing a merging of the digital, physical, and biological realms using advanced artificial intelligence (AI).

The combination of global high-speed connectivity and advanced AI (both at the edge and in the cloud) establish the necessary conditions for scalable and cost effective, global wireless electronic monitoring (WEM)—allowing EM programs to become an end-to-end solution: Vessel --- Cloud ---- Reviewer. An end-to-end solution provides the video reviewer opportunities to analyze video using online platforms, and to communicate back and forth to the vessel via secure management VPNs.

Methodology

Integrated Monitoring[2] is leading the way forward in the world of WEM, and has implemented cloud-based video monitoring, control, and surveillance applications for the maritime sector in more than 10 countries. This includes the flagship on-line review platform—Monitor—which provides real-time access to video, GPS tracks and telemetry on any device. Monitor is designed for regulators and supply chain partners to use as a remote video review platform, based on web-based data standards and end to end encryption and security protocols.

Key to successful WEM is to design for a wireless model of video transmission and storage from the start. This means optimizing the EM system hardware and software to minimize the amount of bandwidth and data needed to transfer large video files from the vessel to the cloud. To do so requires the use of leading-edge video compression algorithms and

[1] The major competitors in the high speed satellite internet space are: SpaceX, OneWeb, Viasat, Amazon's Project Kuiper, HughesNet, and Telesat. SpaceX currently has full global coverage with over 4,000 low-earth orbiting satellites launched. SpaceX has permission to loft 12,000 Starlink craft and has applied for approval to deploy 30,000 more satellites on top of that. https://www.space.com/spacex-launch-starlink-group-2-5

[2] Integrated Monitoring was founded in 2018 in Boston, Massachusetts. www.integratedmonitoring.net

advanced AI models—both on the vessel and in the cloud, typically AWS. The use of AI for WEM replaces the need for costly gear sensors, as critical tracking events and high frame rate video can be selectively transferred off the vessel using machine vision.

As wireless video streaming—via satellite and cellular—becomes the predominant means of data transmission, continued improvements to the efficiency of standard video compression technologies are expected to reduce costs. To enhance the video compression capabilities, we moved the more powerful compression step from the cameras themselves to our EM Server, which benefits from the higher quality GPU-based video encoder. Our video pipeline uses the H.265 codec; variable-bitrate encoding; and dynamic keyframes.

Results and Discussion

Taken together, these optimizations reduce data storage requirements by ≈40%, at the same image quality. Finally, our cloud-based AI solutions, using AWS, reduce video file size, minimize storage costs, and allows us to completely replace physical gear sensors. Further improvements to AI algorithms can then optimize exactly which data needs to be uploaded, enabling the global maritime fleet to benefit from an extraordinary increase in internet bandwidth as new and upgraded satellite constellations come into service.

Innovations like these are supported by dramatic improvements in global connectivity—including 5G cellular, broadband satellite Internet, and edge-based machine vision processing. At Integrated Monitoring we use these technologies to provide faster object detection and reactions; predictions delivered in real-time from vessels located thousands of miles away; and, for the commercial fishing industry, real-time analytics on catch & discards to improve supply-chain efficiency and the quality of scientific research.

Everything then comes together in our online video review platform, Monitor. Monitor is the only cloud-native video review platform on the market, with the ability to scale from an ultra-wide 4K monitor down to an Android or iPhone for owner access to their own video. With the use of a cloud native solution—fishermen, regulators, and the supply chain will be able to leverage the fast-moving pace of AI and machine vision—including integration and sharing of additional data sources, critical for fisheries management and science.

Additional key features such as support for native API integration, cloud compute and Glacier Storage ensure that as technology improves legacy footage can still be used to teach machine vision models for that greater good of the industry. Monitor can also integrate with existing logbook data to pre-populate event lanes based on risk or based on AI algorithms running in the cloud. As review progresses, any adjustments (to the AI predictions) made by the video reviewer provide an automatic feedback loop that continues to train and evolve the AI algorithms that drive the predictions.

Conclusion

Ultimately, as wireless data costs continue to decrease and new satellite internet technologies are made available and affordable to use in remote places that have historically been hard to monitor—like the high seas fisheries—there will be very little use cases for hard drive disk transfers. Perhaps one of the key roadblocks towards rapid deployment and advancement in applications are the regulators and governments themselves.

Many fisheries management authorities still store video and other fisheries data on physical servers, and don’t have the resources yet to move operations to the cloud. To do so requires higher levels of short-term funding than keeping the status quo; but overtime, the long term benefits significantly outweigh the short-term costs, and every effort to advance fisheries information systems and electronic monitoring programs to a cloud-native, wireless model will pay multiple dividends in the future and establish the necessary conditions to scale EM quickly across multiple jurisdictions.

How much is enough? Review optimisation methods to deliver best value from electronic monitoring

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Introduction

Electronic monitoring (EM) using on-vessel cameras can effectively collect a broad range of data to support fisheries management. Key advantages of EM include its flexibility, scalability, verification capability, and the avoidance of health, safety and logistical challenges that human observer deployments can involve. EM can also offer cost efficiencies relative to other monitoring methods, while cost has been identified as a barrier to adoption (Sylvia et al., 2016; Course et al., 2020; Ewell et al., 2020; Michelin and Zimring, 2020; van Helmond et al., 2020). EM has significant potential to provide the data required for fisheries management by Regional Fisheries Management Organisations (RFMOs), and other fisheries management bodies (Ruiz et al., 2020; Román et al., 2020; WCPFC Secretariat, 2020; Michelin et al., 2021). For example, EM can be used to provide data on fishery catch (retained and discarded), catch handling, fishing gear, and operational characteristics of fisheries such as date, time and location of sets and hauls.

We considered the application of EM to meet a range of fishery monitoring objectives and developed a prototype simulation tool to evaluate the level of EM review needed to support management objectives. We also investigated approaches to maximising the efficiency of EM review, within budgetary limits. We focused on RFMOs managing tuna fisheries, and also evaluated broader applications across other management entities and fishing methods.

Methodology

EM implementation to collect fishery data:

We reviewed the efficacy of EM for collecting fisheries data using published information (including comparative analyses with other monitoring methods), and case studies of EM implementation spanning the Pacific, Indian, and Atlantic Oceans. We drew on case studies, published information and practitioner experience to investigate approaches to increase the efficiency, and reduce the cost, of EM review.

Simulating minimum required EM review rates:

To investigate minimum EM review rates, we prototyped a simulation tool based in R, *EMoptim*, that uses stratified random sampling to address monitoring objectives. We used this tool to evaluate EM review rates when EM is implemented as a standalone monitoring method (noting that other data collection tools that may complement EM could be in use and these should be considered when developing fishery-specific monitoring programmes). *EMoptim* also incorporates a cost estimating function, based on pricing of EM analysis.

Our approach with *EMoptim* involves setting monitoring objectives to be met by EM (single or multiple objectives can be set), and identifying accuracy/confidence requirements (e.g. coefficient of variation, which can differ between objectives), cost limits, or other constraints. Existing fishery knowledge is used to identify strata within which sampling effort is allocated for review. Strata may be defined using statistical reporting areas, gear type, fisheries sector, time periods, identified risks, species characteristics (e.g. distributions of age/size cohorts) or any other factor. Information sources such as risk assessments can also be used to estimate the distribution of taxa of interest and interaction rates (e.g. if fishery-dependent information is inadequate). In general, review to meet compliance monitoring objectives would require much greater certainty (smaller coefficient of variation) than the collection of target catch information for stock management purposes, for example, and such differences can be accommodated when limits are set. Simulation modelling is used to identify the required review rate within the limits set, assuming that 100% of fishing activity is captured on all vessels in the focal fishery.

Using *EMoptim*, and publicly available data (aggregated at 5^{o} x 5^{o} resolution) reported from longline and purse seine fisheries managed by the Western and Central Pacific Fisheries Commission, we evaluated EM review rates appropriate to monitor target and non-target catch to achieve specified coefficients of variation. We also explored optimised rates of EM review with more than one monitoring objective in place. A worked example using *EMoptim* is provided in Pierre et al. (2022).

<u>Results and Discussion</u>

Monitoring objectives to be met by EM and approaches to review of EM imagery and associated information vary among EM programmes, including the case studies considered for this work. Using EM to capture 100% of fishing activity is recognized as best practice, while EM review may be undertaken as a census (all imagery reviewed) or with samples of imagery collected. Auditing EM-derived data against other sources, typically logbook information, offers additional options for review and can highlight strengths and weaknesses in other data sources (e.g. key areas for improving logbook data quality).

EM review efficiency, in terms of time and cost, can be increased by considering review requirements during the EM program design (e.g. development of EM-appropriate data definitions) and on-vessel data capture phases (e.g. lens cleaning to improve image clarity). Efficiency of the review phase itself can also be increased, for example by reviewing at speeds faster than real time and supporting review with computer vision tools and hotkeys.

EM review costs as a proportion of program costs vary from 2.5 – 60% (noting that what is incorporated in published review process costs differs among programmes). Review costs do not scale linearly with review rates, and service providers emphasize that collaboration among themselves, clients and vessel operators is important for maximising cost efficiencies.

Identifying minimum levels of review necessary to provide the data required for management is relevant where resourcing is limited. Results of simulation modelling conducted within *EMoptim* and using WCPFC fishery data showed that minimum effective review rates to estimate catch increase as catch frequency decreases, and as the required coefficient of variation decreases. Stratified random sampling was effective in reducing the level of review required for more commonly caught taxa. However, stratification had little effect on review rates for rare capture events that were geographically widespread. As a result, significantly higher levels of EM review are required to estimate numbers of rare events effectively (e.g. captures of seabirds, cetaceans, turtles).

EM programs often include multiple monitoring objectives, e.g. estimating catch of both target and non-target species. *EMoptim* outputs highlighted that optimising review regimes for different monitoring objectives is most effective among more commonly caught species. The required EM review rate increases dramatically when rarely caught species are considered, such that attempting to "optimise" at a lower review rate is not effective for monitoring catches of these taxa.

When investigating minimum review rates, the following points should also be considered (a full discussion is provided in Pierre et al. 2022):

- Set by set data provide significantly more information about the statistical characteristics of events of interest, and should be used if available. At the aggregate level, set by set variation is no longer apparent.
- In the absence of set-level data, assumptions about the statistical characteristics of events of interest can be based on published literature. Such assumptions strongly influence the estimation of review rates.
- The optimisation approach used by *EMoptim* is based on genetic algorithms (described further in Pierre et al. 2022), and consecutive iterations at the same number of runs are likely to have similar but slightly different outputs. The number of simulations should be increased until emergent review rates show an acceptable level of stability.
- Outside strata with higher review rates set using *EMoptim*, we recommend that a minimum baseline level of random review is maintained, for example, to enable detection of fishery changes.

EM has great potential to collect data cost-effectively at scale to support fisheries management. Information requirements that can be met by EM are broadly consistent across RFMOs and other management bodies. Furthermore, service providers operate across jurisdictional boundaries. Therefore, there is significant potential and opportunity to accelerate the development and adoption of methods to optimize EM review, both in the immediate future and longer term.

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Leveraging stock assessment survey data and machine learning to advance electronic monitoring programs in the northeast, US.

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Introduction

Electronic monitoring (EM) systems that incorporate cameras and sensors to produce a record of fishing activity are used in a wide variety of fisheries. As EM expands as a monitoring tool, there is more information on the functionality and effectiveness of EM technology in fisheries management. Human video review is labor intensive and is often one of the most expensive parts of an EM program. Technologies that automate the processing of video data offer a cost-effective solution to this challenge. Artificial Intelligence enhanced video review workflows have emerged as a promising tool to enhance the efficiency of a human video reviewer, with the potential to dramatically reduce the amount of time needed to review video for remote fishing activities.

Developing machine learning solutions for fisheries demands large, well curated training data sets. NOAA's Northeast Fisheries Science Center is partnering with CVision AI to build an EM video library. This data is representative of some fisher workflows in the Northeast Groundfish Fishery, but also includes collection of high quality ground truth data for characterizing advanced types of video systems, including stereo and Time of Flight (ToF).

Methodology

To build this library, we deployed a video recording system aboard the Fisheries Survey Vessel (FSV) Henry B. Bigelow to collect data during biannual bottom trawl surveys (Figure 1). Resulting data was collected and correlated to 99% of Fisheries Scientific Computer System trawl survey data for matching biological data. After correlation, the video data was used to create a curated groundfish image library to serve as a launchpad for EM machine learning applications. Tools were created to be able to efficiently access the enormous volume of video in a tractable way, transforming raw video into an accessible data set.

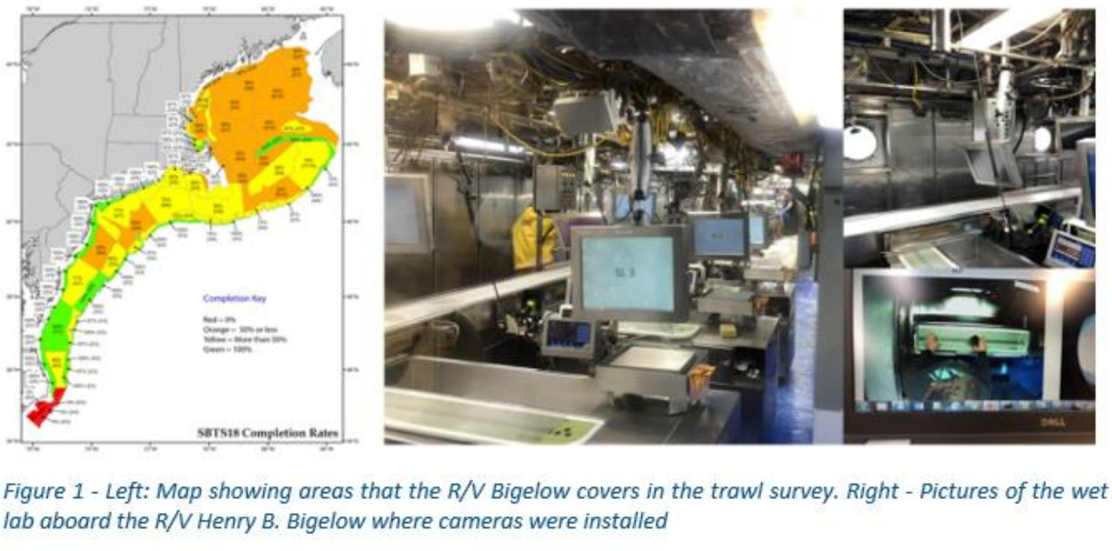

Figure 1 - Left: Map showing areas that the R/V Bigelow covers in the trawl survey. Right - Pictures of the wet lab aboard the R/V Henry B. Bigelow where cameras were installed

Results and Discussion

The project to date has resulted in over 1,622 hours of video recorded with sampling activity, and correlated with FSCS sampling events. Figure 2 shows statistics related to the number of observations, as well as distribution of those observations across species.

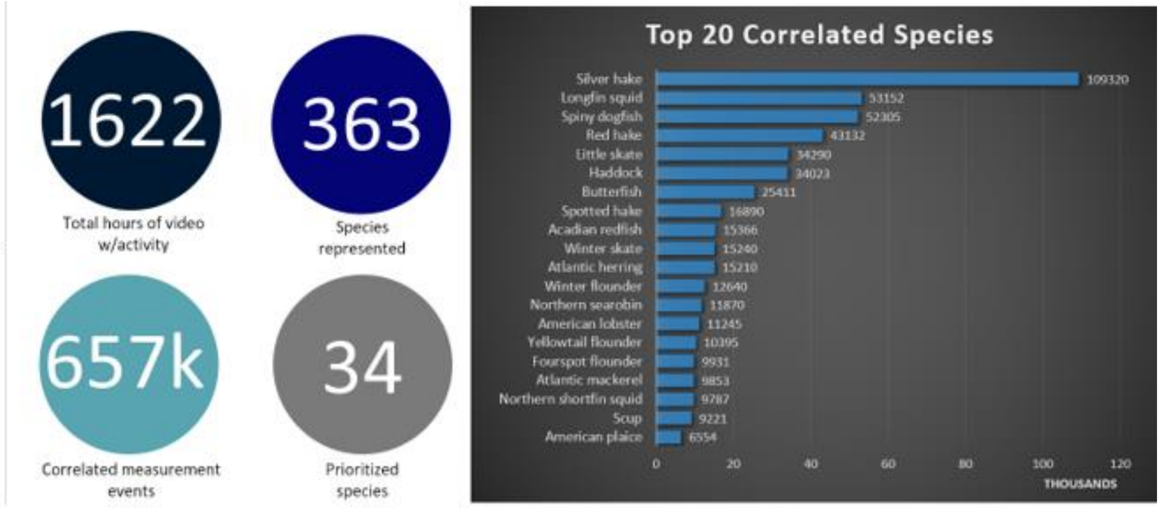

Figure 2 - Statistics related to the data captured in this project

In addition to the observations, we have created a number of tools useful for generating data sets suitable both for rapidly enhancing raw video for algorithm training, as well as for making processing pipelines useful for public release (e.g. PII scrubbing). Figure 3 shows an example of images that were rapidly segmented using our platform Tator, as well as showing how a frame can be presented with a person blurred out.

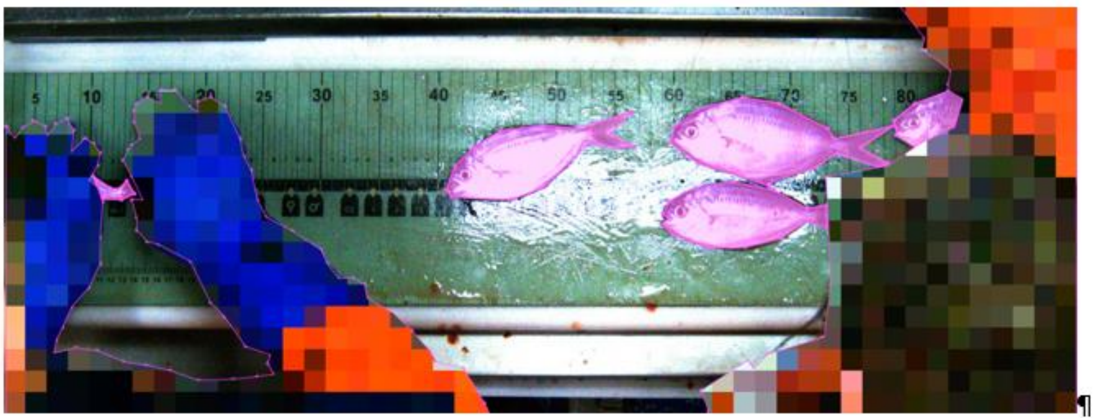

Figure 3 -- Image showing fish automatically detected and segmented using our rapid annotation tools, as well as applying algorithms for blurring humans present in a scene

Using this library, we will determine if machine learning applications can estimate fish size and parse species to the level needed by managers and scientists. The goal is to develop an algorithm that can be integrated and utilized in open-source software products that annotate EM footage. Study results will be used to move the region closer to employing this technology as a means to increase the accuracy of catch reporting while expanding the use of EM to monitor fisheries. More broadly, this work will serve as a template for collecting, cleaning, and curating data for many different types of EM video data.

Abstracts of oral presentations that did not provide Extended Abstracts

Offline LongLine Observer (OLLO) app – empowering observers

Malo Hosken Pacific Community,

New Caledonia

The Offline LongLine Observer (OLLO) application is developed by the Pacific Community (SPC) for Pacific Islands Regional Fisheries Observers monitoring the activities of horizontal longline vessels operating in the Western and Central Pacific area. As an alternative to the paper workbook, OLLO was initially tested by the New Caledonia observer programme in 2020. The core work for an observer is to record catch data for each specimen caught (landed or discarded). For this, the LL-4 form has been developed over decades and is an efficiently table for observers to record quality catch data. While specific attention was given when developing the LL-4 form in OLLO, the feedback from the alpha version trial was simple: "This will never work". The observer was doubting the ease of use and the speed of the application for catch recording. OLLO's betta version responded to this need – the LL-4 is displayed in a tabular format where data fields can be completed rapidly and not necessarily in sequence, a similar feel to when using the paper form. OLLO also allows making gains in terms of data quality using data checking processes in-built into the app and streamlining the data transmission process (38 days lead time for paper versus 6 days for OLLO). OLLO now is being used in five national observer programmes, by 23 observers on 57 vessels for a total of 125 trips representing 2239 sea days. This presentation aims to detail the change process that was initiated and what are the plans for operationalising OLLO at a larger scale.

A more robust approach to assessing the potential costs and benefits of electronic monitoring: a case study of the tuna longline fishery in the Eastern Pacific Ocean

Anthony Rogers

Sea Change Economics, Llc, United States

Tuna fisheries are collectively among the most valuable fisheries in the world. However, adequately monitoring the operations and catch of these fisheries with human observers has often been a challenge due to a combination of cost, logistics, and difficult or unsafe working conditions. There is a growing interest in the use of electronic monitoring (EM) as a potential path forward towards solving this challenge, in particular for longline fisheries, which in many regions of the world have 5% or less observer coverage. However, the potential economic costs and benefits of EM remain unquantified except in very specific cases, limiting the extent to which trade-offs can be assessed and creating a persistent barrier to decisions to move forward with Implementation. This analysis quantifies the potential costs and benefits of a hypothetical adoption of an EM program for the Eastern Pacific Ocean (EPO) longline fishery. Importantly, this work builds upon previous EM cost-benefit analyses by explicitly allowing for uncertainty in cost parameters, in an effort to account for the difficulty in forecasting the effects of rapidly changing technology on a

sparsely quantified fishery. The results suggest that in 99% of all possible cases, an EM system will overall have net positive economic benefits.

Open Discussion Session

Melanie Williamson to Josh Wiersma and Ben Woodward
Q: How far are we from proof of concept to rolling this out in a full-fledged fleet? And do you know of any of the fisheries in the world that are using AI at the moment? And is it effective? And finally, I assume when you are trying to monitor things at night that you're going to be looking at infrared. How far are we in that kind of research?
A. Joshua Wiersma: Our company looks at AI as a tool that is a necessary requirement for wireless electronic monitoring. So we use it primarily for activity recognition. That is, we rely on machine vision to determine fishing activity. We upload the entire trip wirelessly at one frame per second. And then we utilize artificial intelligence in the cloud to determine what's important to bring back at a higher frame rate. So in that way, we're using it and operationalizing it and we think that's the most important actual use case for AI. We think that species ID is cool and sexy but at the end of the day, if you can identify exactly the fishing activity and you can identify the hauls and sets, you get to the point where you're maybe putting a box around a fish.
Ben Woodward: I agree with Josh on the kind of the operational aspect of where AI is right now. Activity recognition gets you to an 85% solution. That's the best bang for your buck on reducing review rates. And that's the closest being a proof of concept. Josh mentioned there's fisheries that are using it and I know a couple other fisheries in the Atlantic that are starting to use AR activity recognition for their reviews. In those cases, it's not for Josh's purpose of reducing the transmitted data back but to hone in reviewers' time spent on processing stuff. And all of the other efforts are really aimed at chipping away at that review time. So you start with activity recognition. Then you Id not just what what's interesting, but the specific interesting sets, hauls, and then you can start chipping away at counts and species identification.

Silvestre Natario to Josh Wiersma and Ben Woodward
Q: Who has the control and the rights to the data generated by EM and other technologies?
A. Data is defined differently by each body, depending on if it's raw data, footage, annotated data, etc. With current use, the video data is often owned by the fisherman, and they can access those recordings whenever they'd like. However, rights to these data categories for electronic monitoring with AI is fragmented per fisheries, per government, and sometimes per contracting companies. There is currently no unified framework for retention policy. The control or rights of these datasets likely won't be an issue until this technology ages and there's more data archived to be put into any sort of analysis that's worth something.

Bubba Cook to panel
Q: What obstacle is the biggest for taking this technology to scale?
A. There's a big upfront cost, and uncertainty of this technology's financial feasibility. Factors such market benefits, market access, efficiency, review of vessel operations, etc. can affect this feasibility even further. Smaller vessels may have trouble powering EM equipment. Some vessels change the area of fishing, thus affecting what is recorded as footage. Some fishermen (or other stakeholders) want nothing to do with implementing EM for their own reasons, whether it be maintenance, cost, privacy, distrust with how the footage would be handled, etc. Governing bodies can also be a challenge. Chile & New

Zealand are pursuing 100% vessel coverage, but that's not a feasible goal for the United States. If EM technology were to ever scale up, it would need to be wireless, as the physical limitations of having people at ports handling hard drives of data would be too financially and logistically cumbersome. There will always be a political burden for implementing EM and their tools, specifically since governments can often not afford to fail as they're held accountable by the public and often by the vessels themselves.

Yoonsuk Jong to Ben Woodward and Joshua Wiersma
Q: What is the current state of the AI tools discussed, are they in their initial testing stages or are they implemented in any way?
A. Box models, used for measuring and recording caught fish, is a simple model and is thus widely available. There is also a lot of experience used for the crew-tracking software, and it is used widely and is expected to be more used once fully combined with cloud uploading tools, comparable to those identifying critical tracking events. The more advanced models are still being developed to be fully implemented; they're becoming more stable as images to train on continue to accumulate.

Claus Reedtz Sparrevohn to Rebecca Darcy
Q: With regards to animal welfare, is there any pressure to look into the handling of both target and bycatch species using Electronic Monitoring?
A. In Australia, there are both state and federal level regulations and programs. There is a Handling Education Program provided by compliance officers that demonstrates to observers & fishers how to handle bycatch species of interest, such as how to hold a turtle by its shell or wounded birds, etc. Regarding target species being mishandled before killing, as seen through EM, there have been instances with cases of improper handling being addressed. However, animal welfare rules don't typically apply very strongly to targeted species.

Sifa Fukofuka to Ben Woodward
Q: How are fish measurements recorded on the screen with the observer doing the biological sample workups?
A. The observers hold a magnet in their right hand, and they place that magnet on the measuring board at the tail end of the fish. That magnet sends a signal to a receiver, where that measurement is recorded. It can then be confirmed alongside the video for confirming that length of that particular animal.

Craig to Joshua Wiersma and Ben Woodward
Q: How far away are we (the stakeholders) from letting the fishery observers and EM analysts have that skillset to go straight to detections rather than having to manually review coverage?
A. With performance standards, there are no perfect algorithms for AI. AI is meant to reduce bias, but it will inherit the human biases within the training datasets. Performance standards would set the bar for the cost level of what one would need with the data required. Once the standards are met and testing parameters are determined, one can compute a working AI EM model that is relatively affordable. Using Edge-based AI may provide insight into risk-prioritization, where you can set review models to say review the top 10-20% of prioritized

hauls. In essence, setting realistic standards in these models and playing smart can allow one to get great, time-saving, affordable EM datasets.

Eric Brasseur to Joshua Wiersma
Q: How are data redundancies dealt with when logging video data in the cloud, particularly with a 1 TB cap (Starlink) introduced in November 2022?
A. Industrial servers holding up to 4 TB of data can also be installed for plans as little as $150/month, storing potentially 6-8 months of fisheries data. Also, when at sea, the 1 TB data cap would not halt uploads, but only slow down upload speeds and transfer to 4G service through Verizon Wireless. As this technology continues to progress, the upload speeds are only going to get faster and more affordable.

Tim Park to Malo Hosken and Joshua Wiersma
Q: What is the timeline and what technology can be used to upload observer data in real-time while offshore?
A. Starlink and similar services are at the forefront. To know when these technologies will be aboard a broad array of vessels, globally, is unknown. Aside from surveying effort, sending real-time data can help bridge gaps in communication among observers and other stakeholders, as well as adding another measure of safety for observers and some compliance needs. This technology exists and is in use, but it’s hard to say when it’s going to be implemented globally and at-scale due to governmental and financial restrictions.

Jennifer Ferdinand to Joshua Wiersma and Ben Woodward
Q: What does the EM review cost look like in other observer programs?
A. Data storage, retention and pre-processing hardware costs have dropped exponentially over the years. Depending on the fishery, 2-60% of costs can be due to reviewing EM footage. Hardware costs used to be much more significantly part of the EM cost. Technology improves in ways where it becomes faster or better, or in some ways both. Therefore, despite review being a large cost (aside from the initial investment cost of hardware), one can imagine this cost lowering over time as the technology evolves while also becoming more readily available.

Mario Lopes Dos Santos to Joshua Wiersma
Q: What are the factors to consider in a risk-analysis for incorporating EM with management processes?
A. There’s a lot of hesitancy in fishers wanting to have all hauls covered, and observer logbooks may need to be compared directly to footage, which can accrue lots of the reviewing cost. The data management requirements of the government may need to be standardized to that body’s requirements, accounting for how precise and broad the data needs to be as well as the financial and non-financial costs of incorporating them.

Poster Presentations - Extended Abstracts

Developing Electronic Monitoring in Pacific Island Countries and Territories Closing the data gap in Longline Fisheries

Leontine Baje, Malo Hosken, Timothy Park, Eparama Loganimoce

Pacific Community, Noumea, New Caledonia

Introduction

The longline fishery in the Western and Central Pacific Ocean (WCPO) has historically low levels of observer coverage of up to only 5% of all trips annually. With limited verification of catch and effort data submitted by fishers, the risk of illegal, unreported, and unregulated fishing is high. Electronic monitoring (EM) which is the use of an onboard camera system linked to satellite GIS technology capturing video imagery of fishing operations was proposed as a suitable option to address the lack of independent data sources for verification of catch and effort data for longline vessels (WCPFC ER&EMWG, 2020). In this context, fishery observers continue observing duties as EM analysts reviewing video files in a designated data review centre. Over the last 10 years seven Pacific Island countries and one territory have entered into EM trials. An overview of the EM development in the Pacific is presented here.

Methodology

Electronic monitoring data deposited at the Pacific Community and relevant literature were reviewed.

Results and Discussion

The seven member countries of the Pacific Community that have trialled and are trialling electronic monitoring are Fiji, Solomon Islands, Marshall Islands, Federated States of Micronesia, Vanuatu, Palau and French Polynesia. Vessels participating in trials were fitted with EM systems and returned records stored in hard drives, these were reviewed in country by national observers or by a service provider[3]. Copies of the resulting annotated data were sent to the Pacific Community Oceanic Fisheries Program to be kept in the Tufman2 regional tuna database where each member country can access through specific reporting and data visualising tools. Over the course of the past decade over 600 longline trips have been monitored using EM and over 8000 individual fishing activities have been reviewed collectively from all trials. Having data review centres set up in country has helped to train national observers. Up to 80 Pacific Island observers have experience in using EM software (Fig 1).

[3] The majority of trials were supported by The Nature Conservancy and used EM systems developed by Satlink. Third party review of data was undertaken by Digital Observer Services (DOS).

Fig 1. EM analyst in the Federated States of Micronesia analysing a trip using Satlink data review software.

Electronic monitoring is viewed as a complementary tool added to a range of existing data collection processes. Assessment of the capability of EM to generate minimum data fields used in the Regional Observer Program for longlines, showed that in some instances EM is not capable of generating certain data fields and therefore observer or port sampling programs would still be required to ensure those fields are collected (Emery et al 2018).

As national efforts begin to focus on EM, discussions, workshops and meetings have been held at the regional and subregional levels on various aspects of EM to provide guidance to countries and begin to establish common standards. Member countries of the Pacific Islands Forum Fisheries Agency (FFA) have adopted an EM policy in 2020 (https://www-staging.ffa.int/download/regional-longline-electronic-monitoring-policy/). Under this policy Standards, Specifications and Procedures (SSPs) that provide a framework for the establishment of EM programs have been established. A key component of the SSPs focuses on data quality and to address this additional data fields are being proposed to be incorporated in the Longline EM Minimum data fields that were developed in 2020 (Table 1). Improving the quality of EM data through data quality control processes is essential to ensure EM derived data can be used in further analysis that generate outcomes for boarder decision making.

Table 1: Key regional developments for electronic monitoring.

Time frame	**Longline EM Development**
2016 - 2019	Draft Standards workshops
2020	Adoption of FFA Longline EM policy Draft DCC Longline EM minimum standards proposed
2021	SSPs for supporting Longline EM Policy
2022	Draft JSON formatted DCC Longline[4] EM Minimum Standards and data quality control process for EM data proposed.

[4] Proposed standards can be accessed at https://oceanfish.spc.int/en/meetingsworkshops/dcc/524-dcc12

Some EM trials have included the testing of machine learning and artificial intelligence in review software. This is developed as applications owned by service providers. There is a possibility for member countries of the Pacific Community to begin development of an annotated image library that would be populated with images from national EM programs. This library can then be used as a tool for machine learning and artificial intelligence. There are several advantages to pursue this which include providing jobs for Pacific Islanders, maintaining intellectual property and ownership, building national capacity, and being directly involved in developing emerging technology. Experienced national observers are well placed to label images and from vessel operations and identify species accurately.

Electronic Monitoring is gradually developing in the Pacific to serve national, regional and industry perspectives. There are several challenges most notably in identifying overall costs and reducing lengthy data review time which increase costs. The seven countries are at different levels of progress. Some are moving towards implementation considering objectives for their EM programs and planning and progressing other critical areas of work such as a cost recovery mechanisms, national EM policy and regulations. Central to the success of EM lies in working closely with industry partners.

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Implementation of remote electronic monitoring in EU fisheries

Miguel Nuevo and Mario Lopes dos Santos

EU Waters and North Atlantic Unit, European Fisheries Control Agency

The implementation of the Landing Obligation in the European Union

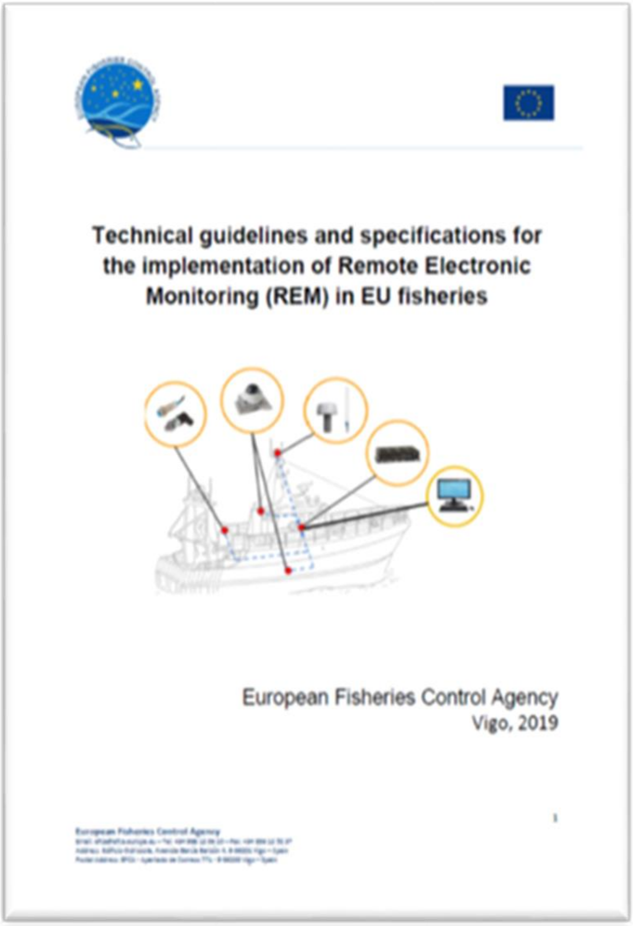
The support of the implementation of the Landing Obligation (LO) is a priority to the European Fisheries Control Agency (EFCA) by conducting several activities to deter possible non-compliance and assess and monitor the level of compliance with this important Common Fisheries Policy provision. Evaluation of compliance with the LO conducted by EFCA concluded that the current control tools are not effective in relation to this provision and other control and monitoring alternatives are needed, such as the use of Remote Electronic Monitoring (REM) or control observers.

The use of REM is recognised as an efficient and cost-effective control tool for monitoring and enforcing the implementation of the LO. In this sense EFCA has been working together with EU Member States (EU MS) regional groups on operational plans for the implementation of REM pilot projects. A revised legal basis / strong commitment by EU MS would be required in this respect.

The EFCA REM Technical Working Group

On request of the EU MS and the European Commission (EC), EFCA had created an REM Technical Working Group (EFCA REM WG) in 2018 to develop technical guidelines and minimal requirements for implementing REM fisheries in the EU. The composition of the EFCA REM WG is open to representatives from all MS and the EC under coordination of EFCA. EFCA organises and chairs the meetings. The EFCA REM WG may invite external experts to some meetings and may also hold joint meetings with other expert's groups if deemed necessary. From the plenary group, subgroups composed by MS involved in REM pilot projects are organised by regions, that meet to discuss relevant operational issues at regional level and report to the plenary EFCA REM WG for developing general guidelines and standards.

The final version of the "Technical guidelines and specifications for the implementation of REM in EU fisheries" was published on the EFCA website in 2019 (https://www.efca.europa.eu/en/content/technical-guidelines-and-specifications-implementation-remote-electronic-monitoring-rem-eu). The guidelines include detailed descriptions on all relevant features of the implementation and operation of REM on board fishing vessels, including Vessel Monitoring Plans, number and type of cameras/sensors needed, self-diagnostics, operational/handling procedures, analysis of the footage, and specification of estimated costs.


Technical guidelines and specifications for the implementation of Remote Electronic Monitoring (REM) in EU fisheries

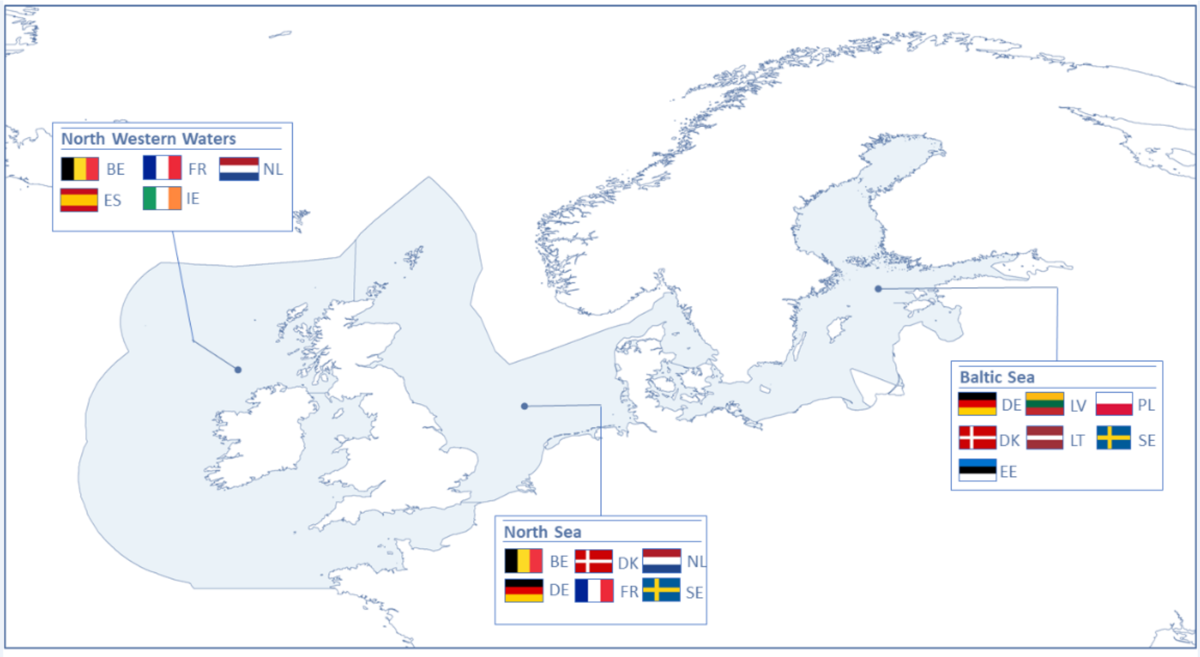
European Fisheries Control Agency
Vigo, 2019

On request of the EFCA Administrative Board (representatives of all EU MS and the EC), the EFCA REM WG reactivated its activities at the end of 2021 to assist MS in the preparation for the implementation of the regional REM pilot projects in the period 2022-2024. The goal is to assist MS in the implementation of the regional pilot projects and consider best practices for REM implementation on fishing vessels, including to provide means to effectively control and enforce the landing obligation at sea and to potentially provide a source of verifiable data.

The technical guidelines are in the process of being updated based on the experience during implementation of regional pilot projects being implemented in 2023-2024 and considering the development of the latest technologies available in the fields of artificial intelligence and machine learning. In 2024 the work of the EFCA REM WG will be evaluated and presented to the EFCA Administrative Board for assessment and decision on continuation.

Support to REM regional pilot projects

EFCA continues the work to address the requests for assistance in the preparation of REM operational plans for pilot projects at regional level. Requests from the Regional Groups (Scheveningen, North Western Waters, and BALTFISH) were addressed and REM pilot projects' operational plans were prepared during 2022. Operational plans for the implementation of REM regional pilot projects were drafted based on the "Technical guidelines and minimal requirements for implementing REM fisheries in the EU". The REM pilot projects' operational plans will be gradually implemented in the period 2023-2024 in several EU sea basins, namely in the EU waters of the North Sea, the Baltic Sea, and the North Atlantic (western waters). Participation in these pilot projects is voluntary and a minimum of 2 fishing vessel per MS have been identified to participate. Areas and MS involved are shown in the map below.



During 2022, there were several meetings of the EFCA REM working group, plenary meetings, and regional subgroup meetings. In September 2022, a request from the NAFO-NEAFC Joint Deployment Plan Steering Group and from the EC was received for the EFCA REM WG to develop Technical Guidelines and specifications for the implementation of REM in NAFO fisheries. This work is being developed in 2023.

EFCA focuses on the use of REM to monitor and control compliance with the LO including monitoring any exemption. EFCA continue to coordinate the EFCA REM WG to provide support and guidelines on how the REM systems should be set-up in fishing vessels in the EU, and to ensure a level playing field is achieved throughout REM implementation.

The Future of Electronic Monitoring in the Atlantic highly migratory species pelagic longline fleet

Ian Miller, Brad McHale

NOAA Fisheries, Atlantic Highly Migratory Species Management Division

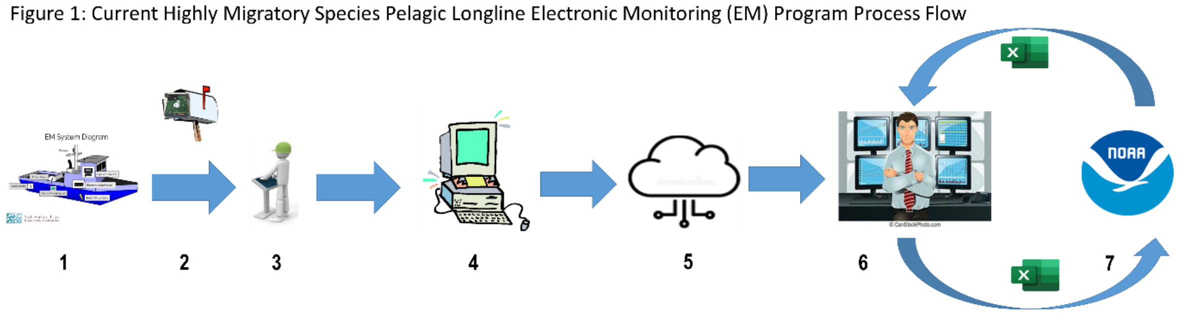
Introduction

The U.S. Atlantic pelagic longline fishery targets bigeye, yellowfin tunas, and swordfish in the western Atlantic Ocean. The management framework includes various electronic technologies to support regulatory objectives. Vessel monitoring systems (VMS) provide spatial information which allows for insight into fishing activities and are used for "real-time" self-reporting of bluefin tuna interactions. These reports are submitted via the VMS unit at the end of each fishing set haul back, which provides bluefin tuna interaction data to NMFS. This data is vital to the NMFS to monitor the bluefin tuna catch shares program (IBQ). Video electronic monitoring (EM) has been implemented on the Atlantic pelagic longline fleet as a compliance tool to support the IBQ program. Pelagic longline vessel owners/operators are required to have EM systems on their vessels that record haul back activity, so that NMFS can monitor bluefin tuna interactions. These tools were developed in 2015 and proved effective in the management of the EM program, since 2015 the technology has evolved, and the time is ripe for exploration of future technological integrations which have the potential to reduce review time, reduce storage needs, expand data transmission methods, and further reduce data collection to programmatic goals. Recent regulatory actions such as draft Amendment 13 HMS are exploring the use of booms and mats to increase detection of in-water discard events and get more accurate measurements of the retained fish. Future enhancements could include AI algorithms that tag footage for review, in real-time reduce the recorded footage to target species, conduct data analysis in real-time among other applications. This Poster explores the Pelagic Longline EM program in 2040.

Methodology

The current EM program data flow requires 7 steps for data to go from collected on the vessel to review. These steps do not have any automation and are time intensive.

Figure 1: Current Highly Migratory Species Pelagic Longline Electronic Monitoring (EM) Program Process Flow



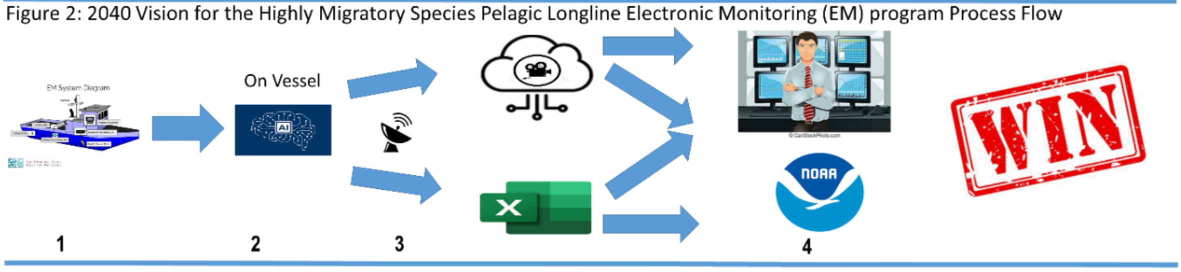
1. Data are collected on vessels by the EM system; data are recorded on a removable hard disk drive.
2. Hard drives are mailed to NOAA Fisheries' designated representative.
3. A disk operator logs in the hard drive to a shipping log, then enters the information in the EM tracking application.

4. The hard drive is entered into a local pre-processing server which extracts the footage and pre-processes it for quality control.
5. Data are transferred to a cloud server, which is then made available through a web-based user interface.
6. EM data analysts review the footage and extrapolate information related to bluefin interactions.
7. NOAA Fisheries receives the processed data in an Excel file; NOAA Fisheries subsequently selects sets for review and sends the selection list to the analyst. Approximately 10% of sets are reviewed per year.

Result: A labor intensive multistep process with multiple single points of failure.

Data flow in 2040 may look significantly different.

Figure 2: 2040 Vision for the Highly Migratory Species Pelagic Longline Electronic Monitoring (EM) program Process Flow



Future method outlined above with reduce steps from data collection to data review
1. Vessels record footage to onboard processing servers.
2. AI algorithms remove non-fishing footage, compress footage, annotate, classify, and record number of fish to the species level.
3. All species records are transmitted wirelessly to contracted review staff and NOAA Fisheries; simultaneously processed footage is transmitted wirelessly to a cloud storage environment.
4. NOAA Fisheries and Review staff can access footage through a web-based user interface.
*All footage would be processed and classified; only 10% of footage would be audited by reviewers to verify outputs and train algorithm.

Result: A streamlined approach that minimizes human input and maximizes automation to gain efficiency. (WIN!)

<u>Results and Discussion</u>

Many current operational and pilot EM programs within NOAA Fisheries utilize a similar workflow as outline in Figure 1. While this workflow has generally met the needs of NOAA Fisheries, it does not allow for real-time data retrieval and continues to have numerous single points of failure, such as a hard drive failure or loss in the mail. In these instances the data are lost. Additionally, steps that require human interactions are time-intensive and can be expensive.

An approach that allows for increased automation can both reduce ongoing operational costs (with admitted increased upfront costs) and can remove single points of failure by utilizing data transmission methods that can be tracked and monitored in real time. The continued evolution of satellite connectivity will only further enable EM programs to provide data to end users in near real time.

References

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NOAA Fisheries, 2019. Three-Year Review of the Individual Bluefin Quota Program: Atlantic Bluefin Management Measures, October 10, 2019, NOAA, NOAA Fisheries, HMS Management Division

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Abstracts of poster presentations that did not provide Extended Abstracts

Innovative software solution for the accurate and efficient capture and reporting of fisheries data.

Amos Barkai

OLSPS, South Africa

In order to address present shortcomings in the way commercial fishing data are recorded, reported and managed, OLSPS has developed “Olrac”, an advanced Electronic Logbook application (eLog) for the electronic collection, transmission, tracing, and reporting of commercial fishing data. The Olrac eLog allows any kind of commercial fishing data to be recorded and reported with great ease in real time or shortly after the fishing event was ended.

Olrac eLog consists of two main components: a vessel unit named Olrac Dynamic Data Logger (OlracDDL) and a web-based fleet management unit, named Olrac Dynamic Data Manager (OlracDDM). OlracDDL is an onboard, multi-platforms (desktop/tablet/mobile) and multi-OS (Windows, Android and iOS) software solution for the recording, visualization, reporting, and management of commercial fishing data. The OlracDDL system can record any type of data (real-time/post event) using various data entry tools (lists, numbers, text, images, videos) and produce reports intended for multiple purposes, including commercial, scientific, statutory, and traceability services. OlracDDM is a web-based data and reports management system. It can read and store data from an entire fishing fleet, aggregating it for further analysis, and supplies spatial representations of data and vessel activities. Additionally, this web solution can distribute data and reports in any format, with automatic verification, authentication, and validation.

Olrac offers number of value-added utilities to complement and enhance the core Olrac eLog Solution. Example is a Bycatch Avoidance Solution that allows users to send bycatch CPUE data to the Olrac shore system in real time. These data are then used by the Olrac shore system to automatically generate a fleet aggregated bycatch CPUE density maps showing areas where bycatch CPUE is high, without giving away the targeted species hotspots, and send these maps to the entire fishing fleet automatically, so high bycatch CPUE area can be avoided.

VISIMII: Towards an automated efficient AI-based stereo vision system for determining species-length distributions on board of commercial fishery vessels and the fish auction.

Sander Delacauw

Flanders Research Institute for Agriculture, Fisheries and Food, Belgium

In recent years, remote electronic monitoring (REM) has been increasingly used in fisheries to efficiently map fishing activities and catches. In order to support a good fisheries policy, it is important to collect sufficiently reliable data to make a realistic estimate of the total commercial catches and discards. However, the current Belgian fisheries observer method only covers in average 1,5% of the total fishing effort, exposing the need for a more intensive sampling program in an efficient manner. Cameras could solve this problem, since it has the potential to capture a more representative catch coverage. In many countries, cameras are used today, with images reviewed in a later stage. However, the current approach is quite time consuming, since a lot of the image screening is still done manually. Recently, deep learning techniques emerged with high potential to automate this process. In the VISIMII (EMFF funded) project the focus will therefore be how we can automate the length-distribution data collection of fish using deep learning techniques such as identification, segmentation, classification and tracking. Using stereo vision we can not only determine the species composition, but also determine the length and volume of these species, provided that good calibration is performed. The aim is to build a compact movable system, easy to install on board of a commercial vessel and fish auction, and capable of measuring accurately under variable conditions, such as light and humidity. The focus will be on real-time image analysis and transmission, to make camera techniques quick and efficient, and to make sure that only processed compact data is transferred. In combination with sufficient metadata, this data could serve as a tool for stock assessment. In the future it can also contribute to real time heat maps and catch prediction models, leading to a more efficient and sustainable fisheries.

Session 4. Observer safety

Leader: John La Fargue

Observers face many challenges and risks in the course of their duties. They must deal with cultural differences, stress, fatigue, isolation, unsafe vessels and sometimes even violence. Programs have the task of helping observers cope with these factors through support, training and the provision of technology/equipment. This session explored some of the issues faced by observers and how protocols, training and technology can help reduce the risks associated with observing.

Oral Presentations - Extended Abstracts

Standardizing vessel safety checklists

Kate Walter

NOAA - Southeast Fisheries Science Center

At the beginning of 2020, leadership from NOAA began a realignment process among several branches. In the NOAA Southeast Fisheries Science Center, there are three observer programs that cover commercial shrimp and reef fish trips across the Gulf of Mexico, the south Atlantic, and the Caribbean. The programs were moved to the Fisheries Statistics Division, and a branch chief was hired. Under this new leadership, the goal was to increase collaboration between the observer programs with a centralized vision of increasing the collection of high-quality data. With delays due to COVID, the program realignment steps began in early 2021. In May of 2022, the first major project discussed amongst coordinator staff from all SEFSC programs was how to standardize the vessel safety checklists.

All three programs are managed by the same contractor, and a few observers have been cross-trained in different gear types. Due to the nature of this labor-intensive position, observer retention past a year is difficult. The aim is to keep observers around for longer terms with the opportunity to gain additional skills and data collection experience with a cross-training program. Conversely, there are various vessel lengths for each program and many of the vessels do not easily fit into one category (vessel lengths 22-110ft). Incorporating the needs of all three programs was not an easy task as there are several gear types in all three programs; shrimp and skimmer trawl, pelagic longline, reef bottom longline, gillnet, handline, bandit, modified buoy/jug, and spearfishing.

One of the major goals of the new safety checklist was to provide all viable options, but not overwhelm the observer with potential choices. The time constraints and pressure from onlooking captains and crew can create early tension which can distract the observer from recording the correct information at arguably the most important time. Federal regulation page references were also added to the formatted boxes and the specific language from regulations was used (“readily accessible”, “float-free”, stowed correctly, etc.).

We began by reviewing the main differences among the three unique forms that were currently being used as well as referencing other regional observer programs in the United States (Hawaii, Northeast, Alaska, North Pacific, West Coast Groundfish). Everyone agreed that the North Pacific format was ideal and provided a great template for the starting point. Using a google document, staff were able to comment on specific boxes, the sequence of questions, terminology, and those changes were easily tracked.

During June and July, we shifted our focus and began creating mock-ups. While the new forms were being built, we also discussed each program's policy for every piece of safety gear. Roughly seven versions of the safety checklist were created and discussed prior to a slight pause in the project due to new hire training and schedule conflicts. Meetings resumed in September, and a preliminary final draft was shared with all coordinators, observer program staff, veteran observers, Office of Law Enforcement staff, and the Coast Guard vessel examiners. A few minor edits were added to the document from that feedback and a final product was submitted in October.

The format of the two-page checklist begins with the natural progression by starting with the CG Safety Decal and the distance rating. The vessel length is often provided by the coordinator during the trip assignment and the observer can confirm with the vessel documentation form. Virtually everything on the first page is considered a no-go item. If safety gear is missing, expired, or nonfunctional, observers are trained to not depart on the vessel until those deficiencies are taken care of. Those items are now displayed in red ink (highlighted in previous versions). On the second page is a list of questions to ensure certain safety drills and roles have been discussed with the captain and crew. These questions are non-mandatory and lower-priority. The final two components are the names of the crewmembers onboard and the captain's signature.

There were a few hurdles to ongoing progress on this particular project. All three programs had scheduled new hire training and the group could not meet for most of August. Along the way, different program policies arose. Some of the major discussions revolved around EPIRB registration stickers, unmarked hydrostatic releases, and specific fire extinguisher requirements. There are varying degrees of details collected, but overwhelmingly the overlap was much more consistent. Moving forward, the goal will be consistent vessel safety checklist procedures for all observers. The final step will be submitting the updated form in early 2024 for approval within the Paperwork Reduction Act requirements. Pending that approval, the new vessel safety checklist will be implemented for all three programs.

Simultaneously, the group has been standardizing the sampling protocols across the reef programs for Panama City and Galveston as well as developing a tablet application for observers to collect data electronically versus a logbook and paper forms for the reef programs. Future implementation of the form will be utilized on the tablet and the validations for the safety check have already been written into the code and logic that are directly based on vessel length and distance rating. With the wide range of vessel lengths in the program, and the various fishery targets (inshore white shrimp, offshore deep water reef fish), the distance ratings and safety gear requirements change from vessel to vessel. The prompts help guide the observers with the federal regulations for the safety gear requirements for each unique vessel.

In the future, we hope to track and flag any historic data collected from vessels. Utilizing previous selection coverage data, each program would have a rough estimate of expirations of hydrostatic releases, liferaft service dates, flares, etc. Coordinators could remind vessel owners and captains during the assignment call when those items would likely need to be renewed prior to their next trip. Those preemptive questions could save the observer from a tough conversation or a potential missed trip due to safety gear deficiencies.

In the time being, we have now included a preview of the common safety check deficiencies in our observer coverage selection letters; a picture of the EPIRB registration sticker, correct life raft setup, flare count, etc. Another advantage of keeping the safety check consistent amongst all programs will help captains and owners with multiple permits and selections to have a standard expectation for every observer prior to an assigned trip.

FINAL DRAFT BELOW

VESSEL SAFETY CHECKLIST

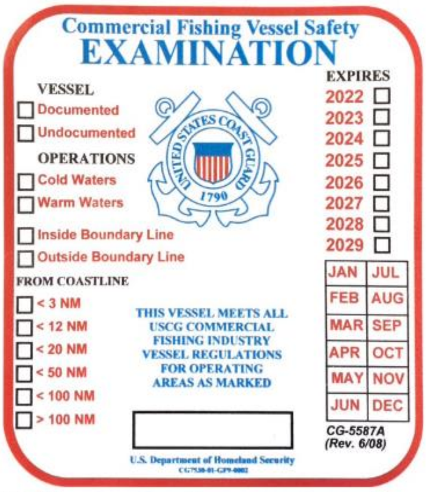
VESSEL NAME: ____________________ **VESSEL #:** ___________________ **OBS. TRIP #:** _______________

USCG DOCUMENTED / STATE REGISTERED

NO GO ITEMS IN RED

USCG SAFETY DECAL: pg. 1

Mark the sticker as it appears on the vessel.



Vessel Length: ___________ *ft*

Is the decal valid? Y N

EPIRB : pg. 13

Type (circle): CAT I CAT II NOT REQUIRED

Location: __________________

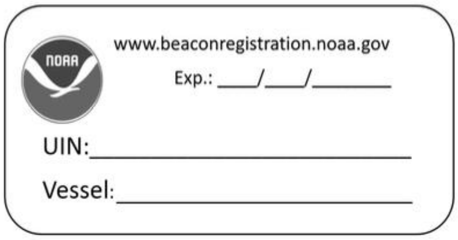
Float Free/ Readily Accessible? Y N N/A

Battery Exp: ____/________

Hydrostatic Release Exp: ____/________

NOAA Registration Valid? Y N

Mark the sticker as it appears on the vessel.



Does the Beacon ID on NOAA Registration match the UIN on EPRIB? Y N

SURVIVAL CRAFT: pg. 6 - 9

- ☐ **Inflatable Raft (circle type):**

Solas A Solas B Coastal PA PB Ocean Service

- ☐ **Ovatek w/ valid Solas kit**
- ☐ **IBA**
- ☐ **Buoyant Apparatus**
- ☐ **Not Required**

Total Capacity:______

Total number of POB: _______

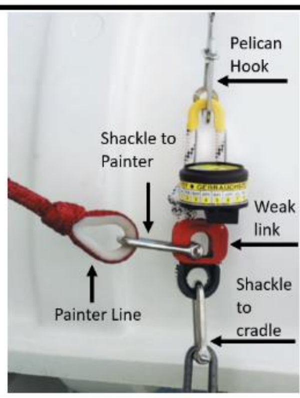
Float Free/ Readily Accessible? Y N N/A

Service Due Decal Exp Date: ____/________

Hydrostatic Release Exp Date: ____/________

Is the hydrostatic release setup properly?

Y N N/A



FIRE EXTINGUISHERS: pg. 14 - 16

Number: ________

Charged extinguishers found in every main area? Y N

Location: ________________ **Location:** __________________

Location: ________________ **Location:** __________________

DISTRESS SIGNALS: pg. 11

Location: ___________________________

	(number)	**(Exp. month/year – earliest date)**
Parachute	______	_____/__________
Smoke	______	_____/__________
Handheld	______	_____/__________

THROWABLE FLOTATION DEVICES: pg. 5

Ring (with attached line) **Lifesling** **Cushion**

Number: _______ **Location (s):** _______________________

Easily accessible/unobstructed? Y N

COMMUNICATION EQUIPMENT: pg. 22 - 23

Number of Working Communication Devices

VHF : _______ **SSB :** _______ **SAT Phones :** _______

Vessel Satellite phone #: ______________________________

PFDS: pg. 3 - 4

Number: _______ **Location (s):** _____________________

Available for everyone on board? Y N

IMMERSION SUITS: pg. 3 - 4

*Immersion Suits required above 32'00 N Latitude for documented vessels.

Number: ________ **Location (s)**____________________

Available for everyone on board? Y N

VESSEL SAFETY CHECKLIST

PLACEHOLDER FOR OMB# / EXPIRATION DATE **OBS. TRIP #:** ______________

ADDITIONAL SAFETY CHECKS:

Did the vessel conduct a safety orientation? Y N
Was the General Alarm tested? Y N
Was the High Water Alarm tested? Y N

Discussed your role during an emergency with the captain? Y N

Where will you go during emergencies?

____

Discussed safe places to work on deck with captain/ crew? Y N

Are emergency call instructions posted? Y N
Were instructions for an emergency call discussed? Y N

Watertight doors (when required) - do they close properly? Y N
Hatches/passageways—are they unobstructed? Y N
Exit Routes identified? Y N

First Aid Kit? Y N
Name of individual trained in CPR/First Aid onboard:

____

Did the captain demonstrate vessel controls/taking out of gear? Y N
Will the vessel maintain a wheel watch? Y N
If no, inform the captain, your contractor, and coordinator. Do not remain on the vessel.

OBSERVER'S SIGNATURE: ________________________________ **DATE:** ______________

CAPTAIN'S NAME: ________________________________

CAPTAIN'S SIGNATURE: ________________________________ **DATE:** ______________

Names of POB:
Crew: ____
Crew: ____
Crew: ____
Crew: ____
Crew: ____
Crew: ____

ADDITIONAL COMMENTS/ ISSUES:
REFER TO FEDERAL REGULATIONS FOR DEFICIENCIES

____
____
____
____
____
____
____

Navigating observer harassment in the northeast fisheries observer program

Kristina Thorpe[1]; Margaret Ball[1]; Bridget Harner[1]; Sara Weeks[1], Douglas Beaudreau[2]; Troy Audyatis[2]; Michael Henry[2]; Tyler Staples[2]; Carl Lemire[2]

[1] NOAA Fisheries, Northeast Fisheries Science Center, Fisheries Monitoring and Research Division

[2] NOAA Fisheries, Office of Law Enforcement, Northeast Division

<u>Introduction</u>

The National Marine Fisheries Service (NMFS) Northeast Fisheries Science Center (NEFSC) manages six distinct yet similar monitoring programs; Northeast Fisheries Observer Program (NEFOP), At-Sea Monitoring (ASM), Industry Funded Scallop (IFS), Industry Funded Monitoring (IFM), Dockside Monitoring (DSM) and Electronic Monitoring (EM). The region averages 180 active observers at a given time. For the purpose of this document, the term 'observer' will refer to a human observer working in any one of these programs and the term 'observer program' will collectively refer to all of the observer and monitoring programs administered in the region.

The Northeast observer program certification process begins with a rigorous three week training. Of the many topics addressed in training, observer safety is the highest priority. The safety curriculum not only consists of offshore survival skills and program specific safety protocols, it also includes conflict resolution with special topics like sexual assault and sexual harassment (SASH), health and wellness, at sea communications, observer regulations, incident reporting, a NOAA enforcement overview, and an observer support session with a panel of program staff, Office of Law Enforcement (OLE) and United States Coast Guard (USCG) personnel.

The Northeast US (i.e. Maine to North Carolina) commercial fishing fleet is diverse. The program covers over 1,200 individual vessels for an average of over 8,000 sea days per year. Gear types include trawl, gillnet, longline, handline, pot and trap, and dredge. For observer selection, some fisheries require a Pre-Trip Notification System while others rely on solicitation or formal selection letters. In some fisheries it can be challenging to select vessels and schedule observer coverage, often creating a hostile environment before the observer arrives to embark on a trip.

After a hiatus of observer coverage due to the onset of the COVID-19 pandemic, our program noticed reports documenting SASH incidents at sea. The reports arrived in quick succession which was alarming to program staff, some of whom have been working in the program for twenty years. In response to the reports of SASH, FMO implemented several initiatives with support from external partners to support observers after incidents occurred and began increasing harassment prevention measures. FMO worked with NEFSC leadership and NOAA headquarters to develop an outreach strategy focused on building a safety culture inclusive of both observers and fishermen. NOAA OLE was an important partner in this process and they quickly committed to a shared goal of increasing observer support in the Northeast. OLE listed observer support as one of their highest enforcement priorities, and, in 2022, a collaborative action plan to further support Northeast observers was implemented.

Methodology

FMO analyzed observer harassment-type incidents (i.e. reported allegations) over a five year period from 2018-2022 (Figure 1). Observers can select up to three incident types from a list of 43 when they submit an incident report. To focus on harassment-type incidents, we only evaluated the eleven incident types where reports might identify harassing behaviors: assault, sexual assault, harassment, sexual harassment, intimidation, interference, gear tampering, failure to provide reasonable assistance, difficulty in preforming observer duties, concerns about safety, and ‘other’. Incidents reporting concerns about safety and ‘other’ where harassing-type behavior wasn’t identified were omitted from the analysis.

Using the consensus determination of a committee of experienced observer operations specialists and only the facts provided in the incident report, we ranked the intensity of each harassment-type incident as low, medium, or high. The ranking of low, medium, or high was done within an incident type to differentiate situations of the same broad incident type categorization. The metrics used to rank incident intensity included but was not limited to: how much the behavior was repeated, if there was physical contact or threats of physical contact, how much the individual allegedly crossed a clearly communicated boundary, how much the observer’s psyche was affected by the behavior, if it seemed like the alleged was intending to assault/harass/intimidate/interfere with the observer, and language or tone of the report. The intensity rankings were converted to a scalar numerical value with low=1, medium=2, and severe=3. It’s important to note that what might be a severe incident to a new observer might not affect the same observer in the same way with more experience working in the commercial fishing environment. Relatedly, individuals have different thresholds for tolerating behaviors at sea and we cannot track individual personalities or tolerances.

Once we ranked incidents as low, moderate or high intensity, we applied a numerical modifier to each incident report based on the incident type with a higher modifier representing a higher inherent gravity of that incident type. A lower modifier of 1 was assigned to difficulty in performing observer duties, failure to provide reasonable assistance, and ‘other’ incident types. A modifier of 2 was assigned to gear tampering, intimidation, interference, harassment and sexual harassment incident types. A modifier of 3 was assigned to assault and sexual assault incident types. A modifier of 4 was reserved for extreme cases such as aggravated assault resulting in harm or rape. Fortunately, the Northeast region has no history of these extreme situations. Incidents in which more than one type of incident was reported were assigned the highest associated modifier. We multiplied the incident intensity ranking and the incident type gravity modifier to calculate a final incident severity score (Figure 2). Because of the 1-4 values for each of the 2 input values, incidents could have a final severity score of 1, 2, 4, 6, 9, or 16 where a value of 1 indicates a low severity incident and a value of 9 indicates the highest severity incident we’ve encountered in our program. The combination of incident intensity and inherent gravity of the incident type allow for the comparison of otherwise dissimilar incident reports as the final severity score accounts for the incident type being reported as well as the intensity of the incident described in the details of the report all in a confidential manner.

Results and Discussion

We found that over the last five years observers have been reporting more severe incidents as shown by increasing harassing-type incident reports with high severity scores (6’s-9’s). Our program trains observers to document their experience during an incident in an incident report. Our priority when we receive an incident report is to support the observer and provide resources to help them overcome trauma. Not all incident reports that come to us are egregious enough to be forwarded to OLE for further investigation. Incidents that don’t get forwarded to OLE are closed by the observer program with outreach or compliance assistance.

Incidents of harassment, and especially SASH, have a significantly negative effect on the individuals that have to experience these behaviors in the workplace, but they also have a negative effect on the program as a whole. Addressing hostile work environments from a programmatic standpoint can be key to increasing observer job satisfaction. Increasing incident severity and overall hostility may be on the rise due to current industry stressors: historically high fuel prices, quota cuts, significant increases in monitoring requirements in the Groundfish fishery, high turnover of observers creating an inexperienced cadre, increased regulations, poor crew quality and crew experience, changing climate conditions, and overall fear that observer data will be used against them. We hope to see a decrease in the number and severity of incidents being reported to the program in the future as a result of the implementation of the OLE Action Plan and the increased awareness in the industry that our agency partners are monitoring observer interactions closely.

The OLE Action Plan is a comprehensive and systematic approach to increasing observer support in the field. The plan includes five key elements: observer training, observer round table discussions, increased at sea awareness, targeted operations on problematic vessels, and communications. In addition to the action plan, the observer program initiated a voluntary industry workshop in 2022 addressing basic concerns around SASH. We focused on opening lines of communication in order to create a safety culture where both observers and fishermen are respected and heard. To date we’ve completed six industry workshops and one observer service provider workshop. The workshops have been well received and we will continue to offer them moving forward.

Additionally, we are working with the US National Observer Program toward implementing changes to the Magnuson Stevens Fishery Conservation and Management Act confidentiality regulations to further support observers. Currently, the regulations prohibit certain types of information sharing, specifically personally identifiable information, among the observer community. The proposed changes would allow more information sharing between observers and observer providers with regard to specific information on vessel experiences. Sharing such information improves observer training related to a specific vessel or otherwise, facilitates and encourages communication of safety concerns to improve observer embarking decisions, and enhances observer situational awareness while deployed. Similarly, we’re investigating, in collaboration with the NOAA Office of General Counsel Enforcement Section, the potential to amend the federal System of Records Notice (SORN) in order to allow more information sharing among observers, observer service providers and industry managers. This might allow the observer program to keep a database of problematic operators or vessels and share limited information with observers prior to deployments. These efforts to change the confidentiality regulations and amend the SORN have been cross regional and would benefit observers across the US, not just in our region.

The impacts of our efforts to support observers will likely be more evident in future years when we can reassess incident trends and evaluate changes from 2022 when the OLE Action Plan was implemented and onward. If other programs are experiencing similar issues and successfully measuring impacts to your observers and programs we invite you to connect with us.

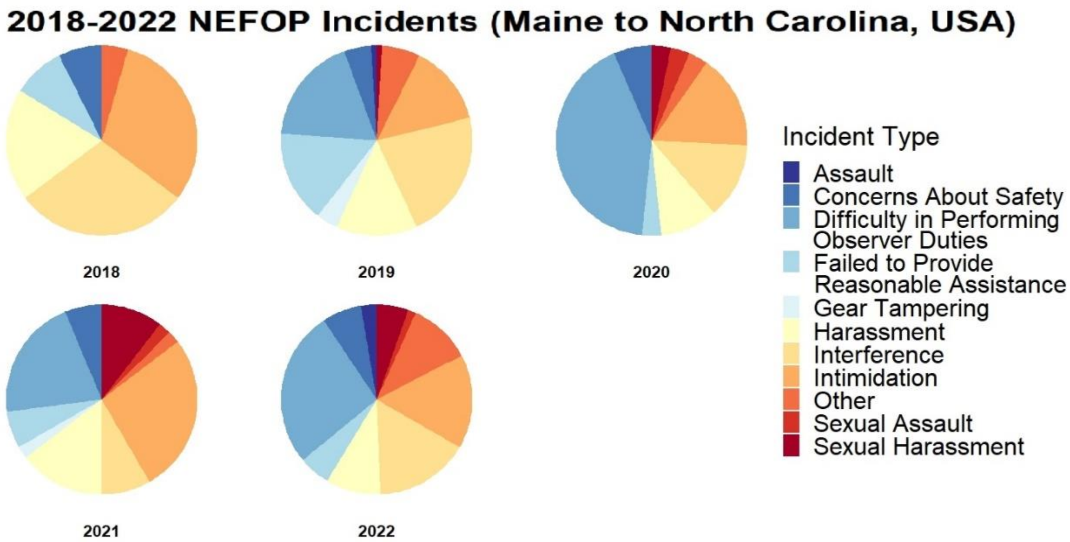


Figure 1. NEFOP incident data from calendar years 2018-2022 showing the proportion of different incident types for harassing-type incidents reported in a given year. Reports with multiple incident types were counted separately.

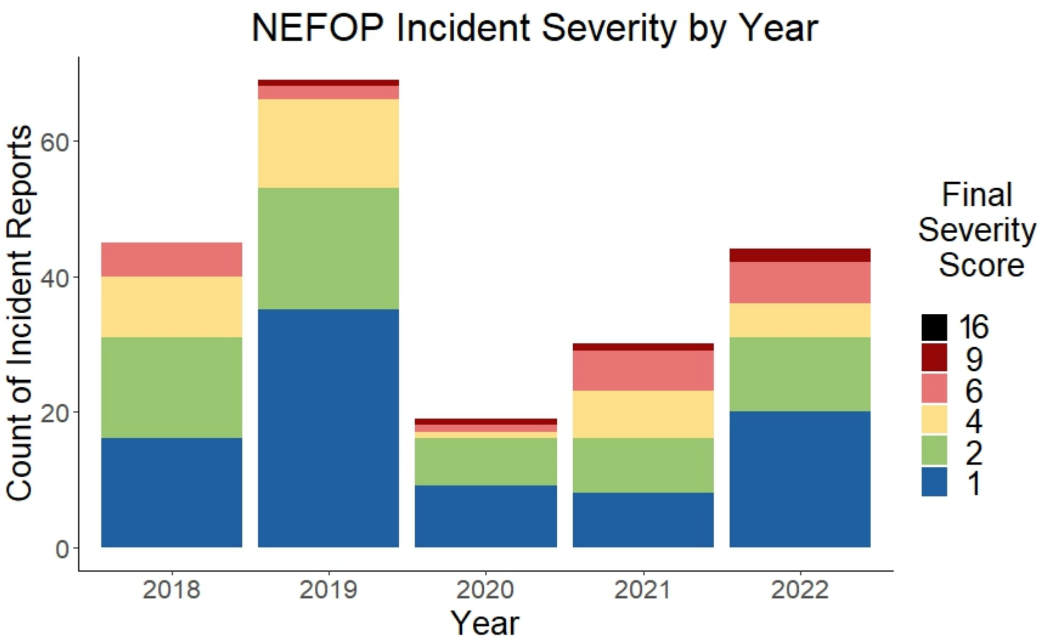


Figure 2. NEFOP harassing-type incidents final severity scores from calendar years 2018-2022.

Note: The Northeast Regional Administrator issued a blanket waiver of observer coverage from March 2020 - August 2020 due to the COVID-19 pandemic. Situational waivers remained in place from August 2020 - June 2021. The dip in incident counts in 2020 and gradual rise in 2021-2022 is related to the number of trip deployments in our program during that time.

Estimates of true observer harassment rates are facilitated by anonymous surveys to correct for nondisclosure

Lacey Jeroue[1], Craig Faunce[2], Andy Kingham[2], Jacyln Smith[3]

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Introduction

Seafarers working in remote ports and onboard fishing vessels operate in high-risk work environments and many find themselves victims of sexual harassment, intimidation, and assault. In support of sustainable fisheries, observers are deployed alongside fishing crews for weeks and months at a time to collect scientific data and report potential crimes they witness. Observers can end up at odds with the crew because the data observers report may indicate a need for changes in quotas, stricter regulation on types of fishing gear, enhanced enforcement of policies, or increased conservation efforts for species impacted by by-catch (Ewell et al. 2020). These activities can increase the chances of potential conflict. Observer safety is prioritized in the United States and observers are encouraged to report accounts of victimizing behavior to the Office of Law Enforcement or their employers. Observers are protected through the Magnuson Stevens Act which categorized harassment as a crime. Despite the support, official reports of observer victimization do not reflect the true prevalence of observer harassment since there are potential crimes that go unreported. Official reports of harassment are typically used as a proxy for victimization but without knowing how many potential crimes went unreported, it is impossible to know the true prevalence of observer victimization. The OLE seeks to allocate resources toward combating the problem of observer harassment but the extent of the problem is unclear because previously, there has been no information about the rate of observer nondisclosure and to what extent the use of official reports as a proxy for total victimization are biased low.

Methodology

To understand barriers to disclosing harassment for fishery observers in the North Pacific, OLE Alaska Division (AKD) sent anonymous surveys to all participating observers each year from 2016 to 2021 (excluding 2020 due to complications with the global pandemic). Survey questions spanned several harassment categories and inquired about specific behaviors. Several questions pertained to a single harassment category so that the breadth of behaviors that comprise a single defined category were covered. Respondents were not directly asked if they experienced a particular harassment category and were unaware of which harassment category a particular question belonged to ensure that any bias associated with harassment labels, or interpretation of harassment terms were avoided. For each question, respondents selected one of three choices: ”No. I did not experience this issue”, “Yes, and I reported this to NMFS (National Marine Fisheries Service) and/or AKD”, or “Yes. I did not report this issue”. Respondents indicated their gender (male, female, other, or decline to answer), age range (24 and under, 25 – 29, 30 – 34, 35 and over, or decline to answer), their employer, and year they started in the profession.

First Model Selection Process - We estimated observer rates of disclosure ($\hat{p}$) with models fitted to survey data from respondents who had experienced victimizing behavior pertaining to AKD priority harassment categories. Priority harassment categories included 1) assault, 2) sexual harassment, and 3) intimidation, coercion and hostile work environments. Logistic regression models with a logit link were fitted to the data and the response was binary as to whether the observer disclosed at least one event of victimization. We used a model selection process to assess the potential contribution of observer gender, age, experience and employment year in influencing the disclosure of victimizing events. Models were ranked by Akaike Information Criterion for small sample size correction (AICc). The model with the lowest AICc value was considered the top performing model from the set of candidate models, however, models that ranked within two AICc were considered as performing equally as well (Burnham and Anderson 2002). Estimated 95% confidence intervals for estimated disclosure rates were constructed via bootstrapping and the upper and lower limits were the 2.5th and 97.5th percentile of the 1,000 bootstrap model estimates following Manly (1997).

Second Model Selection Process - To assess the potential influence of the type of harassment category on observers' willingness to disclose victimizing events, we performed a second model selection process that included harassment category as a possible explanatory variable. Mixed effect logistic regression models with a logit link were fitted to the data and the response was binary as to whether the observer disclosed at least one event of victimization for a given AKD priority category. A random intercept was included for 'respondent' since many observers experienced multiple types of harassment and were therefore repeated in the dataset and violated assumptions of independence. Candidate models included the same potential explanatory variables as the first selection process as well as a categorical variable for AKD priority harassment categories. Models were ranked and confidence intervals were estimated by the same process as detailed above.

We estimated observer annual victimization by expanding the number of observers who submitted official affidavit statements from 2016 to 2020 by the model estimated disclosure rate. Affidavit statements (official reports) were reviewed by AKD to ensure they belonged to one of the AKD priority harassment categories. While multiple affidavit statements may have been submitted during a single year from a single observer, we quantified the total number of observers that reported at least one affidavit statement each year rather than the total number of affidavit statements. Following Thompson (2012), the total number of observers who submitted an affidavit statement pertaining to an AKD priority harassment category (y) can be expressed as the product of the total number of observers who were victimized (V) and the proportion of observers who disclosed victimizing behavior by way of an affidavit statement (p). Hence, estimated victimization was calculated as:

$$\hat{V} = \frac{y}{\hat{p}}$$

<u>Results and Discussion</u>

Survey responses were submitted by 15 - 26.7% of observers from 2016 - 2021 (excluding 2020). Responses came from slightly more female observers than male (45.5 - 62.5% were from female observers). There were 50 - 59.7% of respondents who experienced victimizing behavior (Fig 1) and 21.7 - 28.1% who made at least one official report pertaining to the AKD priority harassment categories. In contrast, only 10% - 15.3% of observers submitted at least one official report pertaining to the AKD priority harassment categories between 2016 and 2020 (Fig 1). There were 347 - 441 participating observers each year and slightly less were female observers than male (44.4 - 47.8% were female). This switch in the gender ratio and high victimization rate suggests that the survey respondents may not represent the observer population and that self-selection of the survey may be biased toward those that had negative experiences as female observers typically experience more harassment.

Results of the first model selection process indicated that observer demographics and employment year did not influence observers' willingness to disclose victimizing behavior. The preferred model was the intercept-only model which had fewer parameters and was only 0.29 AICc from the model that included gender with the lowest AICc. We estimated that the rate of disclosure for victimized observers was 0.43 (95% CI: 0.37 – 0.50). Less than half (43%) of observer's who experienced victimizing behavior disclosed the event.

Results of the second model selection process indicated that observers' willingness to disclose victimizing behavior was influenced by the type of harassment they experienced. The model with the lowest AICc included an effect of AKD harassment category. Estimated rate of disclosure for victimized observers was 0.52 (95% CI: 0.36 – 0.70), 0.36 (95% CI: 0.26 – 0.46) and 0.18 (95% CI: 0.10 – 0.29) for those that experienced assault, intimidation, coercion, and a hostile work environments, and sexual harassment respectively.

After adjusting the number of observers who submitted official affidavit statements by the estimated disclosure rate (0.43) we estimate that 23 - 35% (87 - 133) of observers were victimized each year (Fig 1). The estimated percentage of observers that experienced at least one victimizing event was greater for females than males. There were 13 - 21% (25 - 46) of male and 25 - 53% (41 - 89) of female observers who experienced victimizing behavior. After applying the adjustment from the modeled disclosure rates for each of the three AKD priority harassment categories, we estimate that 0.4 - 2% (2 - 8), 23 - 36% (87 - 124), and 9 to 26% (34 - 108) experienced assault, intimidation, coercion and hostile work environments, and sexual harassment respectively each year (Fig 1).

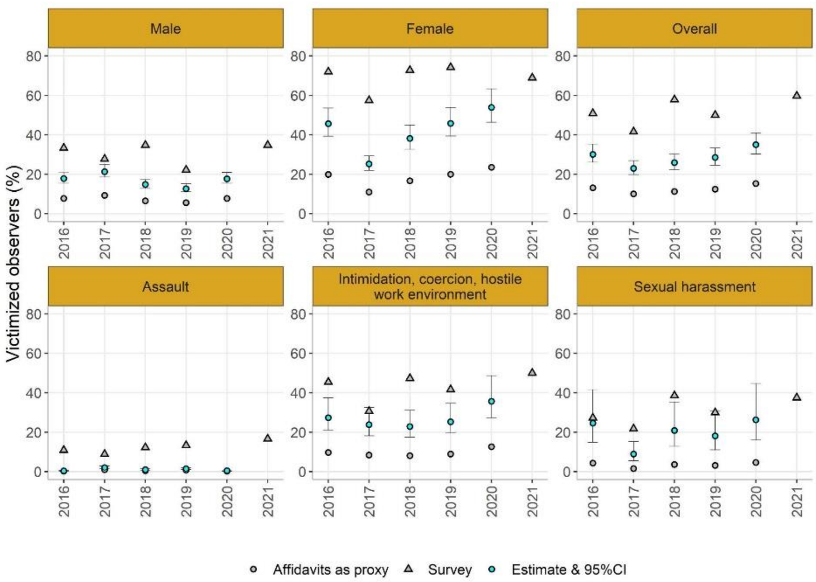

Fig 1. Estimated percent victimized North Pacific fishery observers and 95% confidence intervals each year by gender, harassment category and for overall. Raw percent of victimized observers computed from the AKD survey respondent population (survey) may be biased high while the percent of observers who submitted official affidavit statements as a proxy for victimization (affidavits as proxy) are biased low.

Not all harassment events are disclosed by observers and surveys may be biased towards those that experience harassment. The AKD anonymous surveys that requested information on harassment reporting provided an opportunity to estimate disclosure rates which were used to adjust official records and obtain estimates of the true number of observers who experienced victimizing behavior each year. This analytical method provides a viable means of eliminating bias and obtaining meaningful estimates of victimization when raw rates derived directly from the survey are biased high due to self-selection resulting in a non-representative sample of observers and when the disclosure rate for official reports is low. Obtaining estimates of harassment disclosure rate and true victimization can help fishery programs understand the extent of observer harassment, allocate targeted resources toward risk reduction programs, track rates of disclosure and harassment overtime, and quantify the effects of risk reduction strategies.

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The Frequency of Safety and Harassment Type Violations and the Factors that Impede Disclosure

Jaclyn Smith

National Marine Fisheries Service Office of Law Enforcement

Introduction

National Marine Fisheries Service (NMFS) certified observers are a vital part of fisheries management. Observers are deployed to collect fisheries data in the field; observers often deploy to commercial fishing vessels and work alongside fishers for weeks and months at a time. The work environment observers find themselves in can be challenging, especially if observers find themselves a target for victim-type violations such as sexual harassment, intimidation, or even assault. NMFS Office of Law Enforcement prioritizes investigations into allegations of sexual harassment, hostile work environment, assault, and other complaints, which may affect observers individually.

The Office of Law Enforcement, Alaska Division, conducted an anonymous electronic survey of North Pacific Observers to determine the number of observers who experienced victimizing behavior during deployments in 2019 and 2021. The survey also investigated the reasons that prevented observers from reporting these violations. From these survey results, the Office of Law Enforcement has a better understanding of how often observers are victimized, enabling them to reallocate resources as needed, and conduct more training for observers to ensure they know how to report. Enforcement can also conduct training to ensure people understand what constitutes a victim crime and to increase awareness of potential victimizations. Additionally, the survey results will help law enforcement understand the barriers to disclosure, so enforcement may begin to address these impediments so they no longer prevent observers from disclosure. This survey will also determine if the movement to virtual training and debriefing has impacted the frequency of victimizations, reporting rates, and trust in the justice process.

Methodology

Observers who deployed under the North Pacific Observer Program in 2019 and/or 2021 received a link to an anonymous survey via email. The survey was open to respondents for four months; one reminder email was sent to encourage more participation. The survey contained a demographics section, a section asking about safety related and harassment type situations observers may have experienced while on contract, and a section to determine the impediments that prevented the observer from reporting their experiences. The questions were phrased to identify certain behaviors, such as “While on contract, did anyone make you fear being physically injured?” and “Did you received unwanted or unwelcomed comments of a sexual nature?” rather than asking, “Were you assaulted?” or “Were you sexually harassed?” to prevent observers from being forced to label their experiences. For the Factors Impeding Disclosure section, observers could choose from a list of common barriers to disclosure and could write in their own reasons why didn’t report.

Results and Discussion

In 2020, there was a pandemic that changed the way observers were trained; training was no longer conducted in-person, rather it was conducted virtually, as were all debriefings after a deployment. Observers did not have much opportunity to meet face to face with NMFS or OLE staff due to quarantine and mitigation protocols. This also affected the ability to launch a survey to assess the 2020 deployment year.

The results below represent the percent of observers who responded that they did experience a certain type of safety or harassment issue. Respondents were required to respond to every question. In 2019, 31 out of 173 female observers and 27 out of 210 male observers responded to the survey. In 2021, 45 out of 167 female observers and 23 out of 191 male observers responded to the survey.

Any incident of unwanted unwelcomed behavior towards an observer is one too many. The ultimate goal is to have 0% of observers experiencing unwanted behavior. There are multiple questions that observers indicated they did not experience the behaviors. The majority of the responses fall under 5% of observers responding that they did experience an unwanted behavior. The most frequently experienced unwanted behavior was the receipt of unwelcomed comments of a sexual nature by female observers; 9.25% in 2019 and 12.57% in 2021 received unwelcomed comments of a sexual nature.

Safety and Harassment Violations Types Experienced by Observers on Contract	**2019**		**2021**	
	Female	**Male**	**Female**	**Male**
Feared physical injury	2.31%	1.43%	6.59%	0.00%
Threatened with physical injury	0.58%	0.00%	1.80%	0.00%
Intentionally physically injured	0.58%	0.00%	2.40%	0.00%
Physically prevented from performing duties	0.58%	0.00%	1.20%	0.00%
Threatened to prevent performing duties	1.73%	0.48%	0.60%	0.00%
Forced to, or an attempt to make observer, change data	2.31%	0.00%	1.80%	1.05%
Bribed to change data	0.00%	0.00%	1.80%	0.00%
Received offensive comments made regarding age, sex, sexual orientation, religion, or race/ethnicity	8.09%	0.00%	10.18%	2.62%
Received unwelcome or unwanted comments of a sexual nature	9.25%	0.48%	12.57%	1.05%
Attempts to touch in an unwelcome or unwanted sexual manner	5.20%	0.00%	4.19%	0.00%
Touching in an unwelcome or unwanted sexual manner	3.47%	0.00%	3.59%	0.00%
Forced to participate in any sexual activity against observer's will, or without consent	1.16%	0.00%	0.00%	0.00%
Interference with or biasing sampling procedure	0.00%	0.95%	2.40%	1.57%
Tamper with, destruction of, or discard of samples, equipment, records, photographic film, papers, or personal items	1.16%	0.48%	2.40%	0.52%
Refusal of reasonable assistance which impacted data or data collection	2.89%	0.95%	4.19%	1.57%

Treatment or work environment caused observer to change own behavior or work schedule	8.09%	0.95%	8.98%	1.57%
Required or pressured to perform any duties normally performed by crew members	1.73%	0.00%	1.20%	1.05%
Failure to have a look out/wheel watch	3.47%	0.00%	2.40%	1.57%
Drugs or alcohol use by person(s) operating the vessel, equipment or machinery	5.20%	0.48%	2.99%	2.62%
Unsafe conditions onboard the vessel/at the processor	5.78%	0.95%	5.99%	1.57%

The most noticeable rise in factors impeding disclosure reported by observers from 2019 to 2021 are distrust of NMFS, distrust of Observer Providers, and distrust of OLE. This may relate to the lack of face-to-face contact between observers and NMFS, Observer Providers, and OLE. Without the ability to interact frequently, it can be difficult to build trust and rapport.

Factors Impeding Disclosure	2019	2021
Fear of retaliation	10%	4.20%
Minimized the incident	15%	26.40%
Feared loss of privacy	1.70%	6.90%
Feared it was too late to disclose	1.70%	0%
Couldn't remember all the details	3.30%	1.40%
Felt some guilt about what happened	10%	9.70%
Doesn't trust NMFS	3.30%	15.30%
Doesn't trust Observer provider	6.70%	16.70%
Doesn't trust OLE	1.70%	6.90%
Didn't think anything would be done	18.30%	20.80%
Was afraid of losing job	5%	2.80%
Did not want to get someone else in trouble	8.30%	13.90%
Did not want to go to court	6.70%	2.80%

Conclusion

The Office of Law Enforcement will continue to prioritize the safety and security of observers. Enforcement action should be taken when possible, however, for enforcement action to be taken, observers must be willing to report their experiences. Current training given by the Office of Law Enforcement seeks to build rapport and trust with observers. This type of training will continue, and more interaction between observers and law enforcement will be encouraged. Additionally, the Office of Law Enforcement will continue to work directly with individual fishing companies to address any and all complaints seen in the fleet and on individual vessels. Responsibility for observer safety and security needs to be shared between law enforcement, NMFS, observer contractors, vessel companies and anyone who may have the opportunity to ensure a safe working environment for observers.

Progress Toward a Global Record of Observer Incidents.

Bubba Cook, J.D.

World Wide Fund for Nature (WWF)

Introduction

Since 2009, there have been at least 18 observer fatalities recorded internationally. In each of those cases, national and regional authorities made very little, if any, information available publicly or directly to other jurisdictions. However, fisheries are a global enterprise where vessels and personnel operate across broad ocean areas and multiple jurisdictions where they are subject to carrying observers under various regulatory arrangements. Therefore, what happens in one ocean can have a clear and direct impact in another with respect to observer safety and security. WWF contends that there is a need to address these issues with a global approach in order to ensure the safety and security of observers across the fisheries in which they serve.

Framing the Problem

The problem may be represented through three primary conditions that exist including: (1) Fisheries observers are subject to discrete hazards onboard the vessels on which they serve; (2) Fisheries observers are deployed on vessels that go far out to sea and that might fish in multiple jurisdictions; and (3) An infraction against an observer in one jurisdiction is not recorded in such a way that it will be available or evident to an authority in another jurisdiction.

With respect to the first condition, in addition to the general shipboard hazards faced by all seafarers, it is broadly recognized and supported by evidence that fisheries observers are subject to harassment, intimidation, threats, assault, and even death. In relation to the second condition, research indicates that the vessels operate across oceans and multiple national, regional, and international jurisdictions. These vessels are often licensed and fish across multiple jurisdictions globally. However, regarding the third condition, despite the rapid advancement and availability of state-of-the-art information sharing technologies that allow access to information across the globe instantaneously, there is currently no system to facilitate information sharing regarding infractions against observers. Moreover, in part due to a general lack of consequence, there seems to be little incentive or motivation to move toward developing this information sharing system.

As a result, when an observer is threatened, intimidated, harassed, assaulted, or even killed on a vessel, which should imbue a higher risk of a subsequent observer placement with that vessel and associated crew, responsible authorities currently have no way of identifying and tracking that vessel or crew. Therefore, observer authorities could be continually, unwittingly, and unnecessarily, putting observers at risk.

The Existing Regulatory and Policy Environment

The current state of the regulatory environment with respect to global fishing contributes to the challenges observers face. Various recordkeeping and reporting obligations exist at the national, regional, or international level applicable to observers, but those obligations are often siloed and fail to extend beyond or inform other applicable jurisdictions. This system failure is evidenced by the fact that despite the death and injury of numerous observers under a variety of circumstances in recent years, it is difficult, if not impossible, to determine any trends or even fully account for infringements against those observers. This deficiency is driven, in part, by the fact that a competent regional or international authority is not collectively responsible or authoritatively charged with recording the details surrounding those incidents.

Additionally, while incidents against observers might be recorded locally within a national or sub-regional jurisdiction, they are rarely shared outside that immediate jurisdiction, whether through official channels or, much less, in the public domain. Discrete information about observer incidents is sometimes not even fully recorded and maintained at the national level and what is recorded is often not shared with regional or international authorities. This issue is compounded by the fact that types of information and formats can vary among jurisdictions as to what information should be collected and for what purpose, creating broad inconsistencies among regions. This incongruity in data collection emphasizes the need for a standardized format or, at minimum, standard elements for documenting infringements against observers.

Precedent of Global Coordinating Mechanisms

Several examples exist where international institutions have created mechanisms to address similar issues on a global scale. The Global Record of Fishing Vessels (GRFV), which is a phased and collaborative global initiative to make available, in a rapid way, certified data from State authorities about vessels and vessel-related activities represents an example of a global collaborative information collection and sharing mechanism. The GRFV program aims to provide a single access point for information on vessels used for fishing and fishing-related activities with a primary objective to combat illegal, unreported and unregulated (IUU) fishing by enhancing transparency and traceability. However, while the GRFV and various IUU Vessel Blacklists designed to operate in a similar way are useful examples of cross-jurisdictional and transboundary legal mechanisms for addressing or preventing criminal activities, the reality is that *vessels* do not commit crimes, but, rather, *people* do.

The Person of Interest (POI) standard represents one of the first regional attempts to address people engaged in fisheries crime in a systematic way. The POI standard currently under development by the Pacific Islands Forum Fisheries Agency (FFA) extends from the recognition that information on persons involved in illegal fishing are not being systematically collected, analysed, shared or used to address illegal fishing. The POI initiative maintains a primary objective to profile natural persons and companies involved in IUU fishing, including infringements against observers, specifically in the collection, sharing, and use of such information. This information could then be used to, for instance, determine risk-based placement of observers, identify and recommend additional safety measures if necessary, refuse observer placement on a vessel, or even refuse licensing of a vessel. The FFA has already determined a sound legal basis to collect, share and use POI data and is now in the process of developing further policy and criteria for implementation of the standard.

The European Union recently led an effort to implement a data standardization process designed to streamline integration of fisheries data in a more comprehensive and effective way. The Fisheries Language for Universal eXchange Transportation Layer (FLUX TL) is an information integration system developed to help authorities exchange fisheries control information among themselves in implementing fisheries control measures. FLUX TL uses a new standard that has become the format to exchange electronic fisheries information and data among various fisheries authorities. There is also an associated protocol designed to exchange information effectively without human intervention using state-of-the-art machine learning technologies to guarantee interoperability. Essentially, FLUX TL creates a common language that should facilitate communication among all fisheries information systems and ease data sharing across all platforms.

As an indication of modest progress on this topic, at the recent FAO Committee on Fisheries 35th Session, a country put forward a proposal to establish a central authority and record repository to monitor and record data on crew welfare, including injuries and mortalities, and general support for an established international authority with the remit to monitor, investigate, collect, collate, record, and report on fishing crew welfare. As is often the case, the proposal was significantly watered down and deferred intersessionally, but the FAO did propose that there is a clear need for a coordinated approach to data collection and reporting of accidents and fatalities. Thus, while this action represents nominal progress, there is still much more progress to be made, and, moreover, while the threats to crew welfare are important, the threats to observers remain unique and they must be considered uniquely within this process as it moves forward.

Nonetheless, these initiatives represent the foundation that could make a Global Record of Observer Incidents (GROI) not only possible, but also realistically achievable.

Conclusion

Given the number of recent incidents involving observer injury or death internationally, there is a clear and urgent need to better address observer safety and security. If observers are as important as we insist they are, then we owe it to them to create the infrastructure necessary to ensure their protection on a global scale. In many cases, they are the only source of independently verified catch information and, as a result, a critical piece of our ability to understand our collective marine heritage as well as address IUU effectively across jurisdictions.

There is technically and legally sound precedent for information sharing mechanisms such as that proposed here at the national, regional, and international levels. Moreover, a mechanism such as the GROI would complement and support broader initiatives to combat IUU fishing globally. Because responsible authorities currently cannot assess the information and circumstances associated with these incidents in a collective and comprehensive way, we cannot fully realize solutions to address these incidents at the appropriate scale, leaving observers subject to additional unnecessary risk. Therefore, this proposal calls for a standardized format for collection, compilation, and delivery of information related to observer incidents to be subsequently delivered to a competent international authority that will form a GROI as a necessary and appropriate step to help identify trends, assess relationships, and ascertain risks among observer programs in a way that observer safety and security may be increased on a global scale reflective of our global fisheries.

Recommendations for Moving Forward

Ongoing infractions against observers internationally suggest that the status quo is not an option. Unfortunately, the only concerted efforts to compile and collate observer incidents globally have been *ad hoc* efforts from small advocacy organizations with minimal staff and funding that are reliant on anecdotal or publicly available information. Thus, a more organized official approach must be engaged to genuinely address the collection and analysis of information about observer safety and security infringements on an international scale.

Therefore, we again call for a standardized format for collection and compilation of information related to observer incidents to be subsequently executed and maintained by a competent international authority that will form a Global Record of Observer Incidents as a necessary and appropriate step to help identify trends, assess relationships, and ascertain risks among observer programs a way that observer safety and security may be increased on a global scale reflective of our global fisheries. For example, a collaborative initiative between the United Nations Food and Agriculture Organization (FAO) and International Labor Organization (ILO) that also incorporates crew labor and human rights elements in addition to observer incidents could present a reasonable path forward.

In any case, because we currently cannot assess the information and circumstances associated with incidents involving observers in a comprehensive way, we cannot fully realize solutions to address these incidents at the appropriate scale, leaving observers subject to additional unnecessary risk. Nevertheless, regardless of the ultimate path chosen to address the issue, one thing is clear, which is that action must be taken to ensure the safety and security of observers on a global scale and that by not taking action now we are failing the global observer community.

Open Discussion Session

Caroline Breakell to panel:
Q: Women who are sexually assaulted feel they can't report because they (the women) feel that the crew have information against them (eg falsified data), What is the solution to that problem?
A: Jaclyn Smith - The main concern here is safety. If there is a data issue, it will be sorted out in the observer program. I think that safety takes precedence over that data and observers should as well.
Kristina Thorpe- NOAA Fisheries: If data is falsified, the observer most likely won't take another trip. They also probably wouldn't submit the data. Observer safety is the most important, increased training would help this issue, many captains make allegations about observers so it is all looked into before action is taken

Caroline Breakell to Kristina Thorpe:
Q: What happens when fishers say the observer falsified or consented to the assailant? It happens in Alaska.
A: We always take fisher's words with a grain of salt and will still launch a full investigation. We incorporate SASH into training to help observers understand the process.

Caroline Breakell to Bubba Cook
Q: Is there a crew manifest to track previous harassment on vessels? - There is a national requirement to keep a crew registry but it is not regulated or looked at.
A: There needs to be an international requirement to maintain a crew registry. Crew is disposable which puts observers at risk. Tracking crew is essential to maintain the safety of observers.

Vanessa Fleming to Kristina Thorpe
Q: Why did harrassment increase in 2021?
A: Could be due to the program empowering observers in increased training to report. It could also be due to covid impacts. There are more stressors on fishermen ie. fuel prices, more monitoring, etc.

Vanessa Fleming to Lacey Jeroue
Q: Is there more female reporting because females feel more comfortable coming forward?
A: More females report because they experience more harassment at a higher rate. As far as reporting, it is equal for males and females.

Gwynne Schnaittacher to Kristina Thorpe
Q: I want to recognize the hard work and collaboration of NMFS and OLE. What did the observer providing entail?
A: We sent out "Do Not Harass Observer" flyers to fishers over covered fisheries as well as providers. That usually triggers a response as to why that was sent out and we set the records straight to define harassment and give examples.

Gwynne Schnaittacher to Kristina Thorpe:
Q. Did the content differ between that sent to fishers and providers?

A. No, it's the same content. We use it to also keep the providers in the loop and keep the conversation going.

Tanner Retherford to panel
Q: Could we streamline something to report harassment easier instead of waiting until the end of a long trip or the end of a deployment?
A: Kristina Thorpe: I really like that idea. We could use a Garmin Inreach, an observer has the ability to reach USCG directly. The issue with that is the possibility of the assailant monitoring these devices.
Jaclyn Smith: Same in Alaska. Observers need to communicate if they don't want to get on a vessel, providers need to be on the same page and respect that decision. Industry also needs to understand that. It is important that observers have different options to reach to communicate their issues.

Lisa Borges to Bubba Cook
Q: Some programs in Europe have safety training and gear, others don't. I think there needs to be a need for regional tracking to start to build into the Global crew registry.
A: Absolutely right, We have to start somewhere. We could start regionally, growing nationally, and building internationally. Currently, we can't even identify the vessels if they are changing their names. We need to be able to track and address incidents as they occur. It is crucial, if we can't track, there is no way to implement.

Gabriella Kurz to Jaclyn Smith
Q: Are there any regulations set in place to protect observers from fisher's talking about previous violations?
A: We need to work with the industry directly about that. Fishers need to be reminded that they are responsible for their actions. If there are multiple violations previous to that vessel it is tracked.

Cheng Shi to Kristina Thorpe
Q: When you run these harassment workshops, how do you get industry to attend/engage?
A: We started with three workshops for the groundfish sectors which had a lot of turnout due to the flier distribution. The next three workshops in other fisheries did not have much turnout. We want to be able to do an info blast. The workshops are voluntary at this point so it can be a challenge to get industry to attend. Most of our incident reports come from the groundfish sector.

Cheng Shi to Jaclyn Smith
Q: Is there transparency of incidents among the fishing companies?
A: Incidents do get summarized then sent to the fishing companies, yes. It is then up to them if they want to change out their crew or meet with them to make a change. After that, the incident summary is then released to the entire fishery.

Cheng Shi to Jaclyn Smith
Q: Is it confidential to protect who and when the incident happened?
A: Yes, the names are not released and the report is usually released anywhere from 6 months to a year after the incident.

Cheng Shi to Bubba Cook
Q: If an observer declines to board a vessel at the last minute due to realizing a crew member they identify as a problem, is there a way that the vessel can learn about the crew member so they don't allow that member to move boat to boat and continue working?
A: This would have to change under policy and technological capacity. We would have to come together to share info about crew and vessel incidents. Vessels would also need to do the same. Vessels sometimes don't know about previous incidents when hiring a new crew member.

Cheng Shi to Bubba Cook
Q: Is there a regulation in place for them to not hire problematic crew?
A: Not that I am aware of. I know New Zealand has crew tracking.

Phil Bear to Kristina Thorpe
Q: I have a comment about the issue of the assailant monitoring communication devices such as the Inreach. In my program, (SouthEast United States), we have a few codes that we can use that only we and staff know. Do you have codes in your program? My second question is what can we do about harassment allegations if the fisher isn't convicted? And finally, Are there any consequences for fishers for making false accusations of observers?
A: There are currently no codes put in place, but I really do like that idea. What are your codes? Numbers or words?
Phil Bear: ***- means everything is ok. ***-things are getting uncomfortable but I am ok. ***- Abort, come get me immediately.
Kristina Thorpe: We have been tossing around the idea of making a phrase such as "Can you make me an appointment with Angela?" This would confirm that staff would reach out to USCG to go retrieve that observer. We also have a "Vessel of concern" list that no observers deploy out with until the investigation is complete. And based on the results of the investigation, staff may decide to take that vessel off or leave it on the list. If it decided to take that vessel off, we would put only an experienced observer on the vessel and monitor closely to assess.
Phil Bear: That's great to hear. My only concern is that vessels would purposely get on that list to avoid having an observer.

Matt Walia to Kristina Thorpe
Q: The Garmin Inreach is a gamechanger in reporting incidents in real time. Kristina, can you elaborate more on info sharing with observers about previous incidents on vessels?
A: It is a very complicated question. We are currently working with NOP to change regulations about info sharing. Observers need to know before they get on a vessel if there has been a harassment incident with a current crew member with a previous observer. We also need observers to share that information with each other. The second thing we need to do is amend federal privacy regulations and let people know how their information is shared. It would help with crew knowing about other crew with allegations and observers keeping an eye out for that alleged crew member.

Samantha Chicos to Jaclyn Smith

Q: How do we address observers that feel guilty, don't feel comfortable reporting, or afraid of getting in trouble if they feel they crossed a line by flirting with a crew member?
A: Jaclyn Smith: People Flirt, that just happens. The problem is when it becomes non-consensual. That is when we investigate. We always encourage observers to tell the whole truth. If they are clear about the flirting, we can do a proper investigation. We are aware flirting can happen.

Eric Brasseur to Kristina Thorpe
Q: I think WCGOP is covered with empowering the observer to report. They have multiple tools to either send communication or an SOS. As an observer, if you decide it's an SOS, you hit the button on the PLB.
A: If an observer can send a message explaining what is going on, we know at least that they are alive and ok for that moment. If it is an SOS call, we don't know the severity of the call. Is the boat sinking? Was there a harassment incident? WIth codes, we can at least differentiate the severity of the struggle experienced and take appropriate action.
Eric Brasseur: We are actually updating out EAP to follow up with communication as well.
Bubba Cook: You have to always have someone on the other end of that communication in order to receive and take action. This can be a challenge in the Pacific due to staff hours or simply not having the resources to send out to get observers off the vessel.

Craig Faunce to Bubba Cook
Q: I am absolutely horrified that it was brought up that observers would be scared to come forward and report an incident because it could impact data quality. My question is, how would a global association even happen? Would it be through the UN? A treaty? Or maybe an NGO?
A: It's ambiguous where it currently sits. Someone has to step up and do it. It must be done. They could incorporate observer infractions into algorithm models. They would also monitor the movement of crew and could start recognizing patterns.

Poster Presentations - Extended Abstracts

Developing and implementing an Effective Risk Reduction Strategy

Jaclyn Smith

National Marine Fisheries Service Office of Law Enforcement

Introduction

The protection of fisheries observers is one of the highest priorities of the National Marine Fisheries Service (NMFS) Office of Law Enforcement (OLE). NMFS certified observers deploy to gather scientific data out in the field, often deploying to commercial fishing vessels and working alongside fishers for weeks or months at a time. Working as an observer can be a rewarding and unique experience, but sometimes conflicts can negatively affect the experience. Observers have faced assault, sexual harassment/assault, intimidation, coercion, and otherwise hostile work environments.

Protecting observers needs to be a proactive effort. Developing and implementing an

effective risk reduction strategy is vital to ensuring a safe working environment for observers. OLE created a risk reduction strategy based on Marcus Felson and Lawrence Cohen's Routine Activities of Crime. According to this theory, when you have a convergence of a suitable target, the absence of a capable guardian, and a likely offender, the crime is likely to occur. The risk reduction strategy focuses on each one of the three elements separately. This presentation will explain how OLE developed and implemented a risk reduction strategy that addresses each of the three elements of the Routine Activities Theory.

Suitable Targets

Protecting observers is one of OLE's highest priorities. Likely offenders may view observers as suitable targets to victimize. OLE's strategic approach to the "suitable targets" element is to educate observers and gain their trust. During an observer's initial training, and during the annual briefings, OLE provides training. OLE's training includes defining various forms of harassing behavior, establishing boundaries and resolving conflicts, and documenting and reporting unwanted behavior. Training also discusses the various barriers to disclosure and ways to eliminate them. This training of observers by OLE is the first step in building rapport and earning trust. Trust in law enforcement is necessary for the victim of a crime to report. OLE also builds rapport with observers and earns their trust by engaging with them in the field during routine boardings and an open door policy. OLE also maintains transparency with observers through a quarterly newsletter which highlights enforcement activities and operations, recent case adjudications, reading recommendations, Q &A's, and a meet me section which introduces observers to people within NMFS and the fishing industry they may interact with.

Likely Offenders

It is nearly impossible to predict who may victimize an observer. Law enforcement cannot take action against an individual unless there is evidence of a violation of law. Offenders must be held accountable, and when these offenders are held accountable, the enforcement actions and case adjudications must be made public. This serves multiple purposes. First, when an offender is held accountable, it may dissuade them from engaging in similar behavior in the future, and second, it may dissuade potential offenders from engaging in the same behavior, as they do not want to face the same consequences. It also informs the fishing industry of persons who may not be suitable hires.

OLE also encourages vessel operators and owners to hold their crewmembers responsible for any negative behaviors towards observers. OLE also encourages Bystander Intervention to reduce the opportunity for potential offenders to victimize an observer.

Capable Guardians

The absence of a capable guardian is a key element in the Routine Activities Theory. Without a capable guardian present, a likely offender may have an opportunity to harass or assault a suitable target. Typically, a capable guardian is presumed to be law enforcement. However, a capable guardian is anyone who is willing to step up and intervene when they see someone who threatens the safety and security of others. Joint patrols are conducted with the US Coast Guard and the Alaska Wildlife Troopers to increase law enforcement presence at sea. OLE also works closely with victim advocacy groups, such as NMFS's Workplace Violence Prevention and Response office. It is important to recognize that the first person an observer may disclose an incident involving harassment or assault may be a vessel operator. It is important for NMFS and OLE to work collaboratively with the fishing industry to ensure a safe work environment for observers.

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Observer & adapt: The physical & logistical challenges of observing on reef fish vessels in the southeastern USA

Shane White

Panama City Marine Fisheries Observer of AIS Inc. contracted by NOAA

Panama City Observers:
The Southeast Fisheries Science Center (SEFSC) in Panama City, FL monitors commercial fisheries in the coastal states along the south Atlantic from North Carolina to Florida, and the Gulf of Mexico from Florida to Louisiana. One of these fisheries targets South Atlantic Reef Fish (SARF), such as snappers and groupers. These species are fished with a variety of gear types (Figure 1), each with their own unique data collection and sampling protocol.

This presentation identifies challenges the observer program encounters to observe commercial reef fish fishing effort safely, efficiently, and logistically.

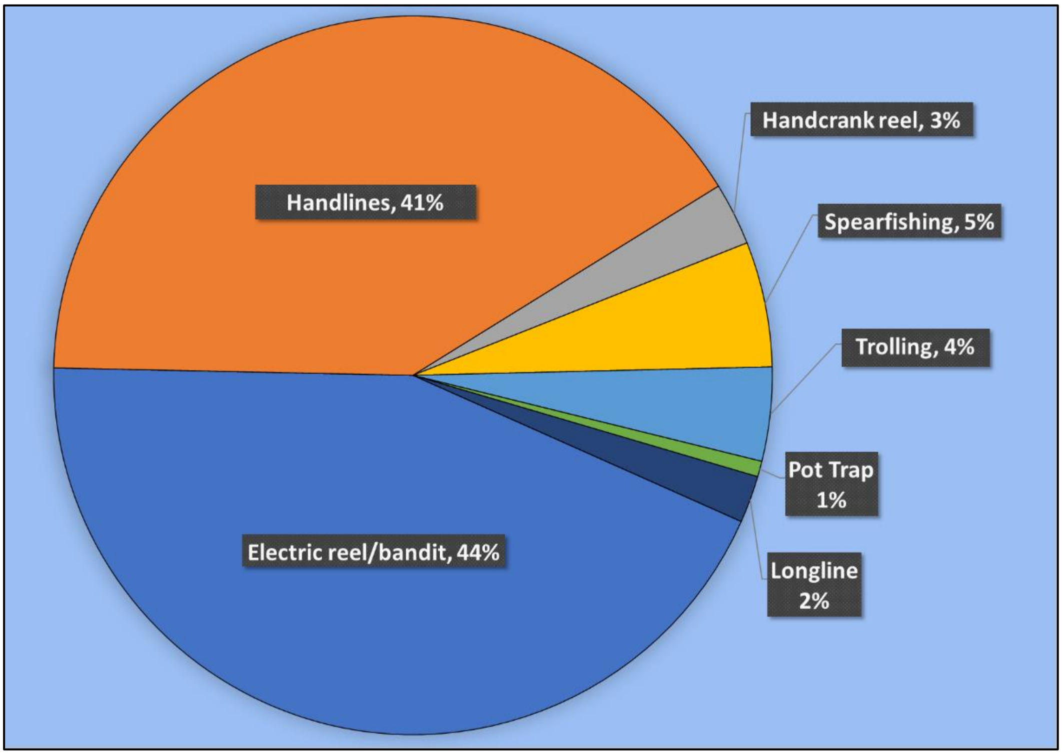

Figure 1: Pie chart displaying the percentages of seven gear types of South Atlantic Reef Fishery vessel permits (n=142) selected for Panama City observer coverage in 2022. The eighth type, buoy gear, omitted from chart as no vessels were selected for that gear type in 2022. Despite these vessels being selected, only 63 (44%) were observed due to logistical constraints. Notice how handlines (n=58) and electric reels (n=62) occupy most selected gear types, as they're popular among fishing for groupers and snappers in the southeastern United States. Pot traps are often associated with black sea bass, trolling with mahi mahi and wahoo, and longline with tilefish species. Vessels are selected through a random lottery process among SARF permit holders. Although the number of vessels selected for 2022 was 132, some were selected for multiple gear types as they had multiple permits of different fishing gear types.

Weather & Logistics:
From June to November, the southeastern United States experience their annual hurricane season, where offshore winds may range from 69-177 km/h (39-110 mph), and storm surge waves as high as 4.6 m (15 ft).

Commercial fishing vessels in these regions are subject to weather conditions changing quickly and dramatically. Therefore, the fishers are forced to seek optimal weather windows, requiring observers and coordinators to be prepared to deploy with short notice.

The geographic area these observers are assigned to covers over 3,830 km (2,380 miles) of coastline, recurring the observers to regularly travel hundreds of kilometers for each trip.

Vessel Size & Observing:
South Atlantic Reef Fish (SARF) vessel lengths (Figure 2) may range from 6.0-20.0 m (19.0-65.5 ft) and vary by gear type and target fish species, making them more detrimentally affected by fluctuating sea conditions than larger, more stable vessels.

With such limited deck space and potentially rough seas, the observer must find ways to safely and effectively maneuver the deck, handle large or dangerous animals, sample species of interest, and discard or tag unkept species.

These duties must be done while monitoring and recording the appropriate data of numerous gears in simultaneous use, and without impeding fishing duties.

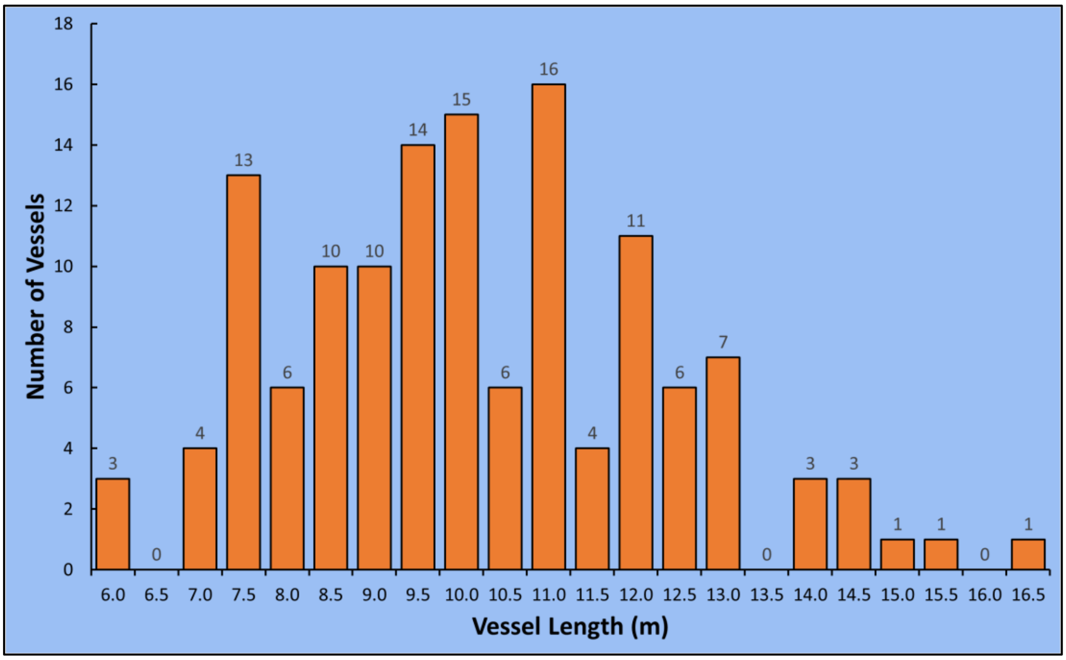

Figure 2: Frequency chart depicting the abundance of South Atlantic Reef Fish boats (n=131) of each vessel length (mean 10.4±2.3 m), as selected for observer coverage in 2022. Vessel lengths shown rounded to the nearest half of a meter. In feet, vessels ranged from 19.0 ft to 54.3 ft (mean 34.0±8.0 ft). One outlier vessel (20 m, 65.5 ft), which had longline fishing gear, was omitted from graph representation.

Mitigation Strategies:
Erratic weather patterns, logistical constraints, and limited vessel sizes present significant challenges for observing reef fishes in the southeastern United States, but there are ways to mitigate these.

Panama City observers are strategically stationed around the southeast United States in the fishing ports with the greatest effort, largely in the states of North Carolina and Florida (Figure 3). A selected reef fish captain may leave within a 24 hours' notice, and so it's beneficial to station observers in different areas. Frequent, consistent, and clear communication between observers, coordinators, and fishers, even while at sea, is necessary for such planning.

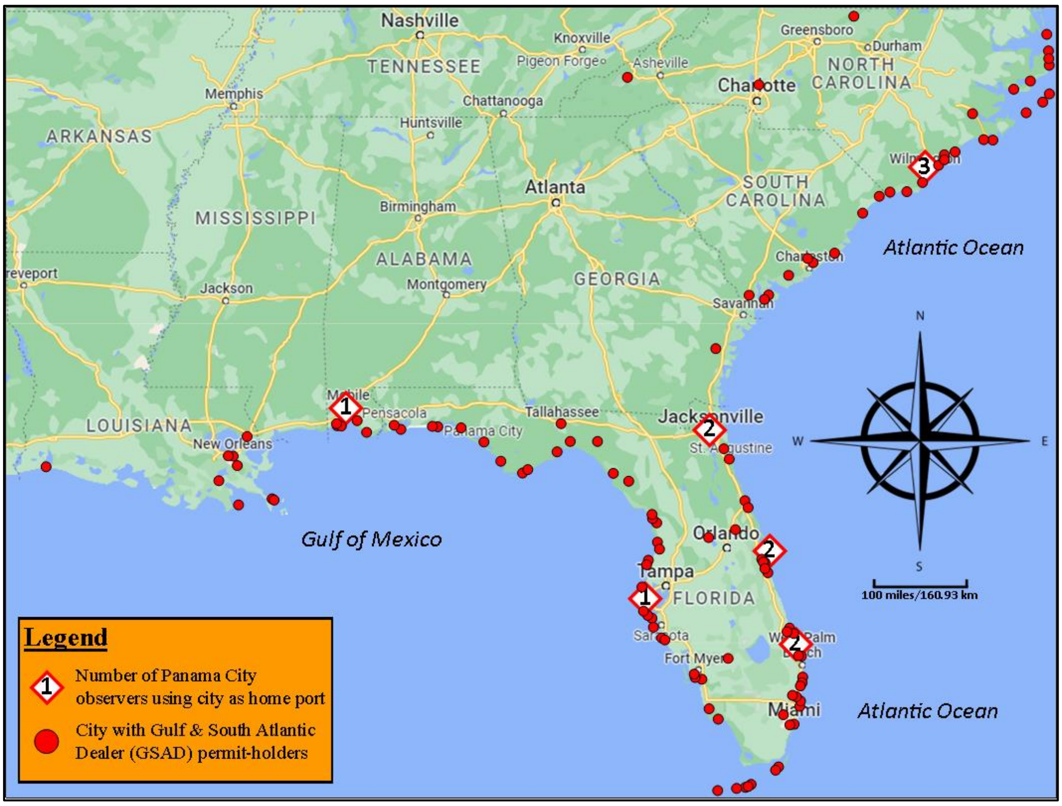

Figure 3: Panama City observers (n=11) and their home ports relative to cities with Gulf & South Atlantic Dealer permit holders (n=173), whom may have dozens of fish houses and thus dozens more of SARF commercial vessels employed. Notice more observers in FL and NC, correlated with more cities with GSAD permit holders (n=103 and n=34, respectively), and thus more SARF vessel prospects for observer coverage.

Prioritizing safety is essential for observing and especially critical with small reef fish vessels. Safety protocol includes conducting pre-trip safety checks, observers bringing safety equipment (ex. EPIRB, immersion suit, etc.) on trips, and knowing one's physical limits. Completing pre-trip debriefs instills confidence in observers (ex. familiarity with fishing practices, recording protocol, and equipment use) allowing them to perform their data-recording duties in a manner that minimizes any breach of safety or fishing interference.

Although these challenges are typical in this program, many unexpected challenges occur on a trip-by-trip basis. Challenges observers face will change in response to fluctuations in funding, increase in consumer demand for seafood, reef fish populations changes, and fishing equipment technology innovation. Despite this, common denominators between current and future solutions would be consistent communication among observer staff and commercial fishers, prioritizing observer safety, and diligent training.

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Abstracts of poster presentations that did not provide Extended Abstracts

Navigating Relationships While at Sea: An Observer's Perspective

Lewis Koplin

National Oceanic and Atmospheric Administration, United States

I began my career as a commercial fisherman at the age of thirteen and later earned a Bachelors in Science in pursuit of becoming a Marine Biologist. This lead me to my current role as a National Marine Fisheries Observer on swordfish vessels. While I have always worked on fishing vessels, the interpersonal relationships that I have developed with the various Captains and crews fundamentally differ depending on my role.

There is an inherent and very obvious symbiotic relationship between a Captain and crew on commercial fishing boats. The crew derives a direct benefit of being employed by their Captain, while the Captain depends on his or her crew to generate revenue. This economically advantageous relationship creates a baseline of mutual respect and willingness to get along.

The mutually beneficial relationship between fishermen and a fishery observer is far less obvious. The field data collected by fishery observers informs and provides a basis for sustainable fishery management, which is ultimately in the best interest of fisheries stakeholders – i.e. fishermen. The observer, however, is often viewed as an uninvited guest, living on their boat, eating their food, and invading their personal space. Maintaining relationships with the Captain and crew can be difficult, but it is critical to navigate these relationships in a conscientious and respectful manner so the two parties can better serve their common interest to maintain and support healthy and long lasting fisheries. Finding a balance is key. Working with them, cooking, cleaning, and being friendly can make all the difference. Think twice before putting your feet up on the table or leaving your sweatshirt in the galley. By being conscientious, observers will have a more positive experience while at sea.

Session 5. Mental well-being of observers

Leader: Lisa Borges

The physical challenges of observing at sea are well known and addressed in training programmes. However, psychological and emotional challenges are issues that can adversely affect an observer's mental health and wellbeing when deployed. During debriefing processes in many programmes observers have displayed frequent signs of depression, reports of feeling helpless, lacking sleep, or eating disorders. This session focused on case studies of mechanisms to deal with mental health issues of observers, as well as strategies, support and training options adopted by observer programmes. It was agreed that this session was extremely important and useful and the conference series should continue to have this dedicated session in the future.

Oral Presentations - Extended Abstracts

Fostering resiliency in an already resilient workforce

Gwynne Schnaittacher

NOAA Fisheries, Alaska Fisheries Science Center, Fisheries Monitoring and Analysis Division, North Pacific Observer Program

Fisheries observers are, by nature, a unique breed. They have opted to work in one of the most dangerous industries in the world. They face challenges and dangerous conditions on a daily basis that would deter most people. Yet, even faced with these challenges, in addition to suffering from burnout and low morale, observers continue to work in this profession. Despite these issues, observers remain resilient and collect the vitally important fisheries-dependent data integral to global fisheries management.

Resilience, in its very basic definition, is the ability to recover from or adjust easily to adversity or change. It is the capacity to adapt successfully in the presence of risk and hardship and to bounce back or forward, from setbacks, trauma, and high stress. This definition likely resonates with anyone that is, has been, or knows an observer. It is important for program managers, observer providers, and observer peers to reflect upon this and consider what we can all do as part of the larger observer community to cultivate this unique skill of resiliency.

A resilient work culture is illustrated by a variety of characteristics. Resilient teams are able to maintain productivity, innovation, and collaboration, and are proactive. In a positive work culture, there is trust among colleagues and between leaders and employees which in turn generates a sense of safety. There are supporting programs in place and benefits available to assist observers who are dealing with trauma and unexpected events. There are policies and practices that provide a feeling of inclusion, diversity, accessibility, and equity that support the workforce, and while there might be adversity, there is still high morale.

Resilient workplaces focus on risk perception, rather than fear of punishment and pointing of fingers and there is the ability to reflect upon lessons learned after a mishap. And lastly, a resilient work environment promotes self-care, encourages social support and time off, and even makes time for play and laughter in the workplace (US Surgeon General 2022).

As program managers, employers, and peers, we must consider what we can do to foster and develop this unique skill set in the observer community. Understanding the impacts we have and implementing processes to hold ourselves accountable are important components of a supportive program. Additional strategies that programs can employ to increase resiliency include supporting in-person interactions and connections, clearly communicating the resources and options available to observers, recognizing policies and practices that work well to support staff and the observer cadre, developing a resilience tool-kit for observers, incorporating mindfulness exercises into training, and lastly, connecting an observer's work to the overall organizational mission, a key element recognized by the US Surgeon General's report released in October 2022 (US Surgeon General 2022). It is crucial that observers feel valued and appreciated.

Observer providers can also strengthen observer resilience through the implementation of strategies such as reviewing employment practices, including occupational health and safety measures, supporting time off, and changing required employment contract commitment. Provider companies are in a unique position to support the rebuilding of the observer community by fostering connections with and amongst employees. A focus on positive feedback and alternative methods to build those connections which may include: remote games, virtual book clubs, happy hours, and keeping observers posted on other observer whereabouts, will encourage community building. Nurturing engagement is particularly important to those who feel isolated, a common issue in the observer community. And lastly, it is important for providers to publicize the resources that are available to employees, particularly those for mental health.

Observers are also accountable through all of this. By focusing on what they can control versus what they cannot and when times are tough, and focusing on their strengths, observers can decrease stress and increase self-confidence. The observer community was fractured during the COVID pandemic; however, by supporting one another observers can rebuild that community. Observers can strive to employ laughter and gratitude in their day, whether that encompasses expressing gratitude outright or keeping a journal, which has proven to have positive effects on one's overall well-being (US Surgeon General 2022). Lastly, observers should communicate to observer programs and employers about what is needed, suggestions for what they can do, and what resources would be helpful.

Resilience is a superpower that allows one to successfully adapt to adversity and risks, allowing one to recover more easily from setbacks, collaborate more effectively with others, and move forward. Cultivating resilience in the observer network can have far-reaching and cascading impacts; not only on data quality, but also more importantly, on the overall health and wellness of observers and potentially leading to longer-term retention of observers in the community. Ultimately, these strategies could lead to a more resilient workforce that has a greater dedication to the mission of supporting sustainable marine resource management on a global level.

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Resiliency Resources

Podcasts

Apps

Presently Delightful Gratitude Journal Affirmation

Video Meditation

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US Surgeon General's Report: Toxic work places are harmful to employee health

Abstracts of oral presentations that did not provide Extended Abstracts

Observer Outreach Team: Connection, Communication, and Camaraderie

Cassandra Donovan

NOAA Fisheries - Northwest Fisheries Science Center, United States

Isolation – physical, mental, emotional – is an inherent part of being an observer. In the best case scenario, you are deployed on a safe boat with a decent crew. Even so, as an observer, you're an outsider – fish cop, Big Brother, etc. Throw a global pandemic in the mix and things only get lonelier. As an observer program, the Fisheries Observation Science (FOS) program empathized with the impact COVID was having on our observers, from quarantining, to extended deployments on the same vessel, to not being allowed to get off the vessel during port calls, and having to isolate back on land.

We created the Observer Outreach Team in the fall of 2020 to engage with our observers and try to give them a sense of community and camaraderie. After each briefing, we provide the observers with an up-to-date observer contact list so they can get in touch with observers in their homeports. Staff members created and maintain port group text threads, to keep lines of communication open amongst co-located observers. We're several issues into the Observer Observer, our for-observers, by-observers newsletter. Our program plans to continue annual observer program all-hands meetings, with topics suggested by the observers. This presentation will introduce our team's work and highlight some of our outreach activities.

The Observer Outreach Team would love to engage with observers and observer programs to hear suggestions and what's working to continue to broaden and deepen the connectivity that we can provide to our hard-working observers.

What is Home to an Observer?

Sarah Yasko

Lynker Technologies LLC, United States

It would seem that the hardest part of living on a fishing vessel is the rolling seas, the continuous changing weather, or lack of communication to the outside world. What they don't tell you is that the sea is an escape. An escape from the ever changing and chaotic lifestyle that observers always seem to inherit. While on land it would be assumed that life would stand still for a moment and all would be sane. That is not the case. As soon as boots transition from boat to land, all forms of routine disintegrate and are cast into a crazy mix of trying to catch up from a month of pure isolation. There is the never ending goal of trying to make up with lost time with loved ones, reaffirming responsibilities that you have shunned, and regaining social constructs that you have lost in your time on the water. The problem is… sometimes you cannot do all these things in your own time or even at all. Most of the time it is a lonely night due to you having a gargantuan amount of free time while typical

nine to fives do not. Other times it is a frantic race of bouncing around place to place, trying to see everyone you can, due to the freed up schedule. It leads more often than not to an exhausted frustration and anxiety. Creating a balance for boat and land life is essential so that observers do not burn out. Knowing the limitations of one's personal self is key to creating a better mental and emotional state so that observers can relax while off duty. Whether running around on adventures or regaining special moments with friends and family, it is important to create stabilization to have a happy and healthy land life.

The role of the Observer Management team to ensure mental wellbeing of Observers

Sihie Victor Ngcongo

Imvelo Blue Environment Consultancy, South Africa

The conditions associated with mental illness are still very much stigmatised in societies and that makes it more difficult for anyone to disclose the symptoms, let alone to seek help. When it comes to the fisheries observers, the landside office support can play a big role in ensuring that issues that can affect the mental wellbeing of the observer are eradicated or minimised. This presentation will focus on highlighting the role of the observer management team to ensure mental wellbeing of observers.

The issues of safety or safety concerns while onboard the vessel can be a major cause of mental instability for the observers. The observer management team can use tools such as MoUs, and observer Briefing and Debriefing sessions to minimise risks. The other important tool can be policies from the fisheries control institutions such as national fisheries departments and regional bodies such as RFMOs.

We Must Address Observer Mental Health

Rachel Howland

Saltwater Inc, United States

Observers in particular face unique stressors with limited ability to seek or obtain help, and as such are more susceptible to experiencing detrimental mental health issues. Mental health has been an increasingly discussed topic for the last several years, and the pandemic brought its importance to the forefront. Despite mental health being clearly acknowledged as a critical issue, few real solutions have been effectively implemented to address the problem. The current approach to addressing mental health among observers is to prematurely end their contract and send them home, but some observers may financially be unable to afford unpaid time off, and therefore avoid mentioning their problems altogether. Overworked observers who desire time off to mentally recover are sometimes begged or offered more money by their employers who are short staffed, putting the employee in a vulnerable position. A robust program that provides accessible mental health resources through all stages of an observer’s deployment is desperately needed. Several important aspects of this program should include, but are not limited to, (1) observer training on mental health awareness and resources, (2) ability to remain anonymous when seeking help, (3) access to specialist mental health services both at sea and on land, and (4) affordability of services. The initial stage of this project seeks to develop a survey for all current and past North Pacific Groundfish Observer Program (NPGOP) observers to gauge the prevalence and severity of mental health issues and identify what help, if any, was sought and received. The results of this survey will be presented with the intention of opening up a dialogue with the observer community, employers and program management.

Open Discussion Session

Bubba Cook to panel
Q: Access to professional services that address mental wellbeing is different in different parts of the world. How to you address the issue where such services are not available and how do you encourage the use of the service in those places?
A. Victor Ngcongo - Getting a different person to talk to the observer would help them to open up.
Gwynne Schnaittacher – The western world has the technology privilege to enable things like instant messaging support to observers. For places that don't have this option, training in self-care and developing different ways to support would be the best solution.

Christa Colway to Victor Ngcongo
Q: Any difficulties in recruiting and retaining observers?
A. Yes. Having a comprehensive debriefing process would help in finding out why observers would leave the programme.

Rachel Mahler to Rachel Howland
Q: Interested to hear more about the observer mentor programme.
A: Sarah Williamson will talk more about it in another session.

Tim Park to Gwynne Schnaittacher
Q: Pacific communities experience a high rate of self-harm among young people. Is there any thing to address this issue?
A: NOAA is developing a training programme for supervisors for mental health issues but don't have a timeline yet. Meanwhile, there is training in mental health first aid available. For people who deal with mental health issues, provide support other is key.

Unidentified to panel
Q: Would having better financial compensation for observers increase the retention rate and reduce mental issues?
A: Rachel Howland: Observing is often a first job out of college, we weren't expecting that the job would we well paid. Wages are paid based on sea days, once you get far into the pay range the income makes it worth the job. When we are talking about retention, is compensation suitable? Mixed views. Pay in Hawaii is comparable, insurance includes therapy, etc. this has shown some benefits.
Victor Ngcongo: Concerns about pay are real, two different observers on one vessel paid more than another can cause tension.

Jennifer Ferdinand to panel
Q: A resilience tool kit is very important. My experience in empathy communication was quite useful to be observant other than judgemental. Self-caring should be done on a daily basis not only after trauma. Access to technology allows for texting with an observer coach on a weekly basis. Having a therapy session would make difference for observers. This early intervention can prevent the mental health issue become a more serious problem.
A. Suggestion for on land, fisheries and contracting companies to have a hired professional available for observers to be able to talk to. This could provide regular hours that they can

drop in to have a chat with. This could be a good resource to use. Consider the impact that wellbeing can have for the finances of an observer.

Andrea Clement to panel
Q: A lot of mental health issues are about bridging the gap between observers and crew, living with people who may have different backgrounds. Do you have any thoughts on preventative measures, interpersonal skills, people entering the workforce for the first time after finishing college/university. Perhaps workshops on conflict resolution, compassionate conversations, information that is useful to the observer – training them about how a vessel works, weather, etc to build a relationship between crew and observers?
A: Cassandra Donovan: One programme does have conflict resolution training, with a field work toolkit including conflict resolution included into their manual. Training included use scenarios based on reality from observers, how did you handle the situation? How would the rest of the group handle that situation? Some people have different personalities to resolve an issue, some may be more assertive, and others less so. Train the trainer, how to teach observers self-safety, how to protect yourself – something that one programme is looking to roll out. A grass roots approach is needed for observers, bring in family and friends, they can be part of the grass roots network. So that people can relate to what observers do at sea, people understand what the experience is like.
Victor Ngcongo: Language is a consideration, translators may be needed on shore, but when at sea the translators are gone. The language barrier affects you.

Isaac Forster to panel:
Q: This is from a western perspective. A model of observer funding where observers are new to the workforce, observers are generally paid contract by contract, or by retainer. The employment model may be one of the contributors to mental health issues. Do you provide any financial training for observers, and is the funding model appropriate?
A: Gwynne Schnaittacher: Concept of financial training is not something they had considered. The observer workforce is young and doesn't have much financial acumen. There are also many different service delivery models. Some observers are expected to sign on that they will work for a year, in others it may be 90-day contracts. It is so wide ranging it is hard to answer that question. Funding is tightly related to how fisheries are managed.
Cassandra Donovan: Useful to have a 'this is how you don't go broke' mentorship, it does make sense to me that we provide this training as the job is entry level. In South Australia we had not considered that, and it is a good take home message.

Michelle Camara to panel
Q: Is there any training you can do for observers to mitigate the rumour mill problem; how can we control that within the industry and among observers? If everyone thinks I'm lazy – maybe I am. Can we learn how to not judge someone?
A: Gwynne Schnaittacher: We had someone resign due to a rumour that the female observer was sleeping with a skipper. It was affecting her mentally and resulted in her resigning as she couldn't get onto a vessel without someone bringing it up. There is always a story about the last observer when you get on board.
Cassandra Donovan: In society in general the rumour mill is something that we struggle with, we need to continue to enforce how rumours hurt people and they can be

detrimental. Expectation setting may be useful for all levels of observing. People need to know what they may be getting themselves into or what the current realities are.
Unidentified: Training should include professionalism, observers are out there to complete a job, everyone, observers, trainers, coordinators need to put a stop to rumours as soon as possible. Everyone needs to watch each other's backs, stop rumours. Training for how to remain professional at sea goes a long way.

Glenn Chamberlain to panel
Q: How to increase observer engagement participation.
A: Steve Todd - Although our programme has a large geo foot print, I don't feel isolated. I have family and an out reach team to support me. I get lots of emails from them. Team building activities are also very good opportunities to connect.
Cassandra Donovan: email sent out to the observer list. Our observers mostly have yearly contracts. We ask what observers want to see, hear in the engagement process and will follow up. Our newsletter is popular.

Eric Brasseur
Q: Who provides InReach devices to their observers? (hands raised), Who has one that can be used to contact family and colleagues? No hands raised. I have an SOP which I can share. Keeping observers connected through InReach at sea with other colleagues may be beneficial.

Poster Presentations - Extended Abstracts

How to maintain mental health and What is your Mental PPE?

Michelle Camara

Lynker Technologies LLC

Everyone that is an observer or that is observer support system knows that life as an observer is a hard life, both physically and mentally. Though most of the time physical dangers are easy to recognize and prepare for, but what about mental dangers? So we should look at mental dangers the same way. First identify the mental issues and then decide what mental PPE should be brought. What is mental PPE? Mental PPE is any item that an observer brings for their mental health. These items can be broken down into two types. There are entertainment PPE and non-entertainment PPE. Why is mental PPE so important to observers? Observers have a strange and interesting job with equally strange and interesting living conditions.

Observers work and live on vessels for extended periods. They are sometimes unwanted guests which can lead to captains and crew being difficult to both live and work with. They are viewed as the government watchdog and some crews are told by captains that any trouble they get into is because of the observer. The crews in some programs do not speak the observer's language which adds another layer of difficulty to sampling and communication. Some crews are abusive to the observers both mentally and physically. Though the instances of physical abuse are a lot lower than the mental abuse, I would say that the mental abuse is far more rampant then discussed in the office because most captains and crews that are abusive are very good at manipulating observers into thinking it's not that bad. The people on the vessel are not the only difficulty on the vessels sometimes it is the vessel it's self that cause problems for sampling and life at sea. They work long hours ranging from around 11 to 17 hours a day for weeks on end. This can lead to messed up sleep schedules. Most hauls are filled with moments of activity and then long periods of nothing, these times are filled with a mind numbing boredom. All of these issues can make an observer feel isolated and lonely while at sea.

Mental PPE is important but so is the time off between the contracts and having resources to talk confidentially about difficulties at sea. Many companies want observers to work specific number of days per contract and though this is great for the bottom line it may not be good for every observer's mental health. This should be understood when an observer asks for time off or to end contracts early. A lot of observers have issues on the vessels but most do not have the resources and know where to turn when things go bad. Counseling services should be available for observers, so they can talk about anything that they need to both about life on the boat and off. This life is hard on us but it is also hard on our relationships and lives.

Observer companies and government agencies should help observers prepare by explaining life on the boats. During training and hiring they should stress how isolating the life on the boats is. That even though each boat is different that as an observer you will always be a separate entity on the vessel. I truly believe that they should stress that it is important to bring self care items. I don't believe that any observer should feel bad for taking the things that make them stay sane on a boat or that will keep them comfortable. I have been told many times that I bring too much. This should not happen because each person is different. It is not anyone else's right to tell me what I need on a boat. There is too much shame if you don't want to rough it, but this old west ideal is what can make people snap out at sea. I am a proponent for taking things that help you feel like a human and help to keep a routine from off the boats. For example a great cup of coffee in the morning or a smoothie that uplifts you for your day, listening to a good podcast or music, reading a good book, or even watching a movie before bed; all of these can make a bad day or trip bearable. Having these things from non-boat time that carry over to your work and life on the boats can keep you feeling normal.

The observers should figure out what kind of person they are. Are they and introvert or extrovert? Introverts will be able to handle the isolation better but extroverts will still be able to work on the boats. Each observer needs to find small things that make them happy. These things can normalize their day. How do you deal with pressure and antagonistic people? Having things that can keep you busy and out of the dark brain spiral will always be good. It is good to bring things with you that make you feel better.

The two types of Mental PPE they are entertainment PPE and non-entertainment PPE. The entertainment mental PPE that observers use consist of books, e-readers, audio books, music, podcasts, movies and videogames to name some. The non entertainment mental PPE consists of coffee press, personal blender, soul foods, large pillows, silk covers, comfortable clothes, and work gear. These items distract the mind and also help keep a routine from off the vessels.

Most mental PPE is personal but the government can issue some things that can be used. Government issued Mental PPE examples are satellite phones/ inreaches. These items should not be only for work communications but also for personal use when needed. There are times on a boat that communication with family and friends can help lighten a bad day or trip. Think about a time when you just needed a kind word from your love one. Now think if you could not call or text that person for another month or so. This is what observers can and do to deal with. This can lead to a feeling of being more isolated. Also in a small way safety equipment can also be seen as mental PPE because if an observer has all the safety equipment this can lessens the stress of life on a boat. Observers have a lot to worry about on their vessel. So having good and properly maintained equipment is one less thing to worry over.

How much Mental PPE is needed well this is a personal thing. Each observer will have to decide for themselves. They will need to ask a few questions; What are some things that you do everyday?, What do you do for entertainment?, What are some comforts that you love? and How do you like to sleep? Then the observer should bring items that will help them keep their routines or entertainment for the dull times of their days. So pick a few items that can make you comfortable like large pillows, mugs for hot drinks etcetera. Also, Pick a few items that are for entertainment like e-readers, music players, movies or video games.

Just REMEMBER companies and governmental employees that observer's life out there is hard. Each observer is their own person so what is good for one may not be good for others.

It must be stressed that it is alright to bring all you need to keep yourself safe and comfortable. Companies and observers should know that it is important to take breaks from the boats when needed. No matter what is brought on a vessel if they do not have time off vessels to remind themselves why they work. There should be also resources that give observers someone to talk to when things get to difficult. This is needed in every program because we are all important out there. The data is only as good as all the observers' mental health. The only reason we should lose an observer is that they got a better job or they wanted to move on.

Measuring and analyzing effects of the COVID-19 pandemic on mental health of North Pacific Fisheries Observers

Raul Ramirez

Fisheries Monitoring and Analysis, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, USA

The COVID-19 pandemic upended the world as we know it, and mental health was one of the first aspects to be affected.

Data reported in May 2020 by the UN that stress and anxiety levels had risen substantially during the COVID-19 pandemic. According to World Health Organization, in the first year of the pandemic, the global prevalence of anxiety and depression increased by a massive 25%. In 2021, the National Institute of Mental Health reported that rates for anxiety, depression, and stress-related symptoms, were almost double those expected before the pandemic.

The observer work, like almost every other aspect of society and human activity, has been deeply impacted due to the COVID pandemic. Since COVID was declared a nationwide emergency on March 2020, 100% of the observers needed certified vaccination and proof that they receive a negative COVID-19 result. Also, they were quarantined for 2 weeks in hotel rooms before arriving at vessels or plants and stayed confined strictly to plants and vessels without the option to walk around, meet coworkers, or have the chance to talk in person to anyone else besides vessel/plant personnel. Repeated testing through short periods of time prior to accessing site works, wearing a mask at all times regardless of vaccination status, and extending the contract from 90 to 120 days increased, even more, the feeling of stress. All these limitations result in an exacerbation of feelings of isolation and depression.

During observers, the debriefing process is common to hear observers expressing signs of depression such as feeling sad or anxious often or all the time, feeling irritable, easily frustrated, or restless, Having trouble falling asleep or staying asleep, eating more or less than usual or having no appetite, experiencing aches, pains, headaches, or stomach problems that do not improve with treatment or feeling tired. Sometimes, they feel helpless or hopeless.

In January 2020, we included a question in the post-deployment plant/vessel survey asking the observers if during their work they experienced feelings or emotions that could affect their performance and/or data quality. The purpose of this question was to try to gauge the mental health state of the observers and look for signs of underlying mental struggle or psychological distress. Data was starting to accumulate in July 2020 and until now, this question has received 4,277 answers

To gauge the observers' state of mental health and to identify signs of underlying psychological distress, in 2020 we added several multiple choice questions to the post-deployment plant/vessel survey asking the observers whether they experienced negative emotions or feelings that ranged from anxiety to sleepiness.

The survey also asked whether the observers encountered uncomfortable situations such as harassment by vessel /plant personnel or a hostile work environment. This information has been recorded since 2013.

The information provided by the observers confirms they have not been exempt from the mental stress caused for the pandemic. At least 58% of the observers experienced some level of emotional discomfort (see chart above). At least 15% of the observer experienced some health issues such as fatigue, disposition change, and/or illness, 8% lack of sleep and 8 % stated that they were feeling depressed during their assignments. On average, 9 of 100 observers suffered from a lack of sleep, stress, and/or loss of appetite.

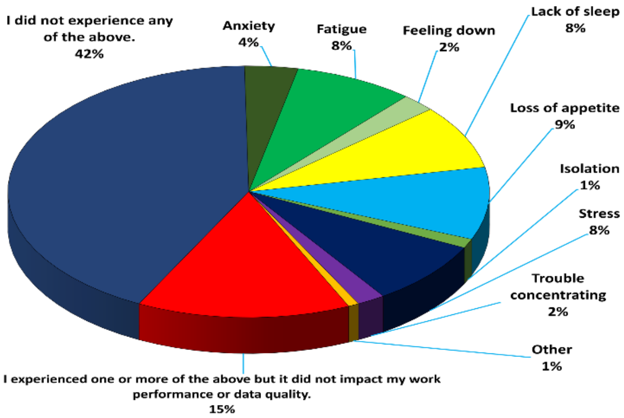


Figure 1. Feelings and emotions reported by observers (July 2020 - December 2022).

Between July and December 2020, almost 70 observers experimented with some crew-related problem, and in the first half of 2021, 47 observers endured conduct that created an intimidating, offensive, or hostile environment during their deployment. In total, 399 conflictive situations were reported during 2020 and 2021 (199.5 per year). Note this is a dramatic increase in the number of cases per year relative to pre-pandemic (73 cases in 2019) or post-pandemic (126 cases in 2022) levels.

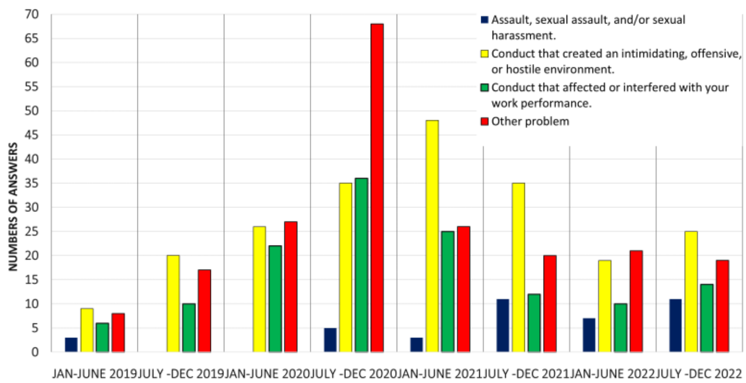


Figure 2. Vessel/plant related issues documented by observers (2019-2022).

The pandemic has generated a rise in the level of anxiety and depression for industry (vessel and plant) personnel. As a consequence, their interactions with observers were more problematic, causing a surge in observer complaints against fisheries industry workers.

Between 2020 and 2022, observers documented 347 egregious violations that resulted in filing statements. These statements were referred to the Office of Law Enforcement (OLE) for further investigation that could result in civil or criminal prosecution. In addition, there was an increase in Intimidation/Coercion/Hostile work environments and Disruptive/Bothersome Behavior/Conflict incidents were reported. In 2020, a dramatic increase in the number of statements reported by observers. 45 cases of intimidation, coercion, and hostile environments were written and 38 cases of disruptive/bothersome behavior were documented.

The North Pacific observer program provided permanent support to the observer's mental health through in-season advising, training, and debriefing. 24-Hour crisis lines are recommended in case the observer feel anxiety or loneliness or presents symptoms of mental illness.

Session 6. Recruitment, training and retention of observers

Leader: Amy Martins

This session explored the process of training, briefing and debriefing observers, a significant component in the multi-step fisheries management process. Trainers and briefers prepare observers for the challenge they face at sea; program staff support observers while they are in the field; and debriefers conduct data quality control measures with all of these interactions ensuring the best available science and compliance information support sustainable fisheries. Training, briefing, and debriefing staff are often the touchstones for observers -- they are the mentors, evaluators, and offer a safe, understanding ear. The interaction between observers and briefing/debriefing staff is vital and yet the time we have to interact with each observer is often incredibly short. These interactions are also important for the retention of observers, which is crucial for running a successful observer programme. This session also addressed strategies to increase observer retention.

Oral Presentations - Extended Abstracts

Modernizing Recruitment for Monitoring Programs

Vanessa Y.M. Fleming

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

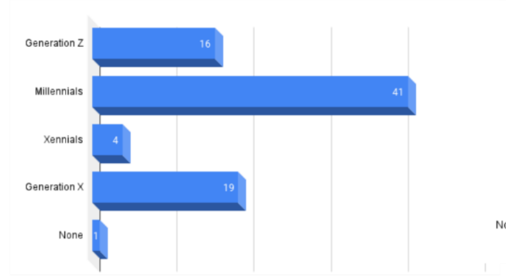
Trends show that recruiting has hit an all-time low since the pandemic. Monitoring programs are recruiting and attempting to retain a younger generation of observers, and the modernization of recruitment could be the solution. The lifestyle of an observer is unique in several ways, from the intense several-week training courses, life during deployment, and relocation to homeport. Monitoring programs have the opportunity to advertise this challenging but rewarding work lifestyle through visual representation on social media.

Social media can be a beneficial marketing tool with more users than ever. Monitoring programs are recruiting a generation that increased their social media usage by 65% in 2021 and is predicted to increase by another 45% in the next three years. This will create a considerable trend driver in the social media landscape. Social media has become mainstream in everyone’s daily routines, with social media platforms available to everyone across the globe. By creating a social media platform for individual monitoring programs, recruitment can reach further, and possible candidates can have a better insight into monitoring programs.

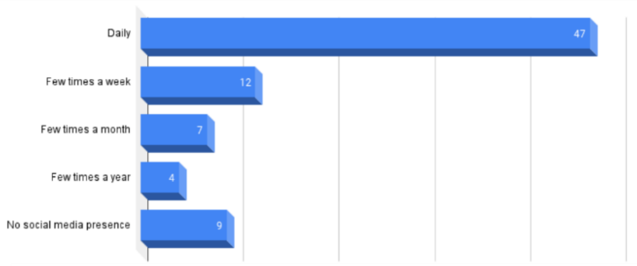
Modernizing recruitment through social media can increase a program's candidate pool and better prepare its trainees for the reality of training, deployment, and life in a homeport. Social media can also create a community within programs by connecting observers through one platform. Social media can build a community across programs designed through social media algorithms, exposing observers or candidates to other similar social media accounts. By preparing candidates for the expectations of the position they are applying for, and creating a community, retention of observers for their contracts or longer could improve.

A survey was conducted across six monitoring programs to assess personal social media usage vs. the generation they identified with and their opinion of three possible benefits of monitoring programs having a social media presence.

70% of survey respondents were either Generation Z or Millennials, with half of the survey respondents currently working as observers. An outstanding 88% of survey respondents said they have a social media presence, with over half using it daily. 9 out of 10 daily users, were either Generation Z or Millennials.



Generation

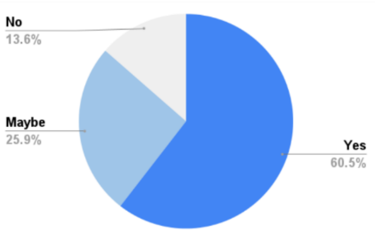


Social Media Usage

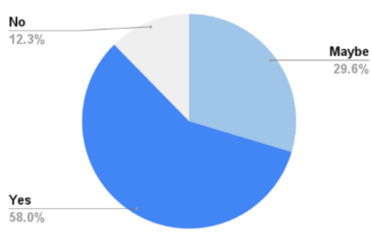
When asked if social media could benefit recruitment by reaching a higher candidate pool and better-preparing candidates for program expectations, an outstanding 87% voted that it would or could. Almost 9 out of 10 were Generation Z or Millennials.

88% of survey respondents said that social media could or would create a community within and across programs. Once again, 9 out of 10 were Generation Z and Millennials.

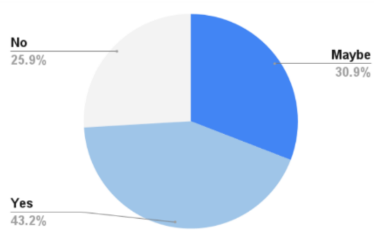
Regarding the final question of social media presence possibly increasing retention, 74% of survey respondents said it would or could. 7 out of 10 were Generation Z and Millennials.



Recruitment



Community



Retention

This data set across six monitoring programs shows that the majority, especially the two generations currently or coming in, believe that modernizing with social media could benefit our programs in several ways. Combining this with research on the benefits of recruiting through social media, it is evident that we must move forward and utilize these modern tools readily available to our programs.

Huge thanks to the West Coast Groundfish Observer Program, At-Sea Hake Observer Program, West Coast Region Observer Program, Southeast Fisheries Science Center, Pacific Islands Region Observer Program, and North Pacific Observer Program for participating in the social media survey for this presentation.

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Current Plummeting Observer Retention Predicament

Rachel A. Mahler

Alaskan Observers Inc. WCGOP

Introduction

The purpose of this project is to investigate and address reasons observers are continuing and departing Observer Programs within the West Coast Groundfish Program (WCGOP), West Coast Regional Program (WCROP), North Pacific Groundfish Program (NPGOP), and Pacific Islands Regional Program (PIROP) on the US West Coast, Alaska, and Hawaii, respectively. The topic of retention is crucial because it directly affects program cost, time invested, institutional knowledge, and with low rates, can add stress to current observers and staff.

In 2022, 31% of new hires in the West Coast Groundfish Program had prematurely terminated their contract. It was affecting current observers directly. It increased observer hours, travel, and burnout affecting mental health, potentially affecting overall data quality (Mayhew and Dietrich 2005).

Methodology

WCGOP observer exit surveys, observer annual reports, and data provided from program administrators were used in conjunction with a six question survey that was produced in January 2023 to target current and previous observers to gain an understanding of why observers were staying or departing the field. The survey, titled *The Observer Feedback Survey,* was distributed through program administrators, via email, and social media observer community groups, including Facebook and Instagram.

The survey broke the respondents into two groups: Current Observers and Previous Observers. It asked the respondent in which programs they have/had participated as an observer, how long they observed for (rounded to the nearest year), and reason(s) for staying or leaving. It went further to ask past observers if they quit before or 2018 and after. Each respondent had an option to add their email for follow up questions.

Results and Discussion

Of the 210 responses, 197 had participated in at least one of the four observer programs. Of the 197 respondents, 70 are current observers and 127 were previous observers.

Over 40% of current observers (Figure 1) have either less than one year or over ten years of experience. It is suspected that location has a factor for observers with over ten years of experience. The majority of previous observer experience is between two and four years.

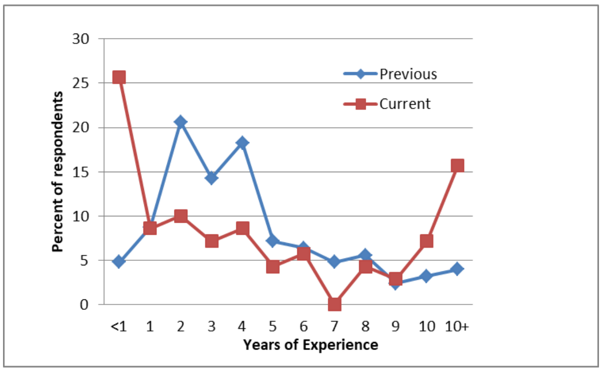

Figure 1

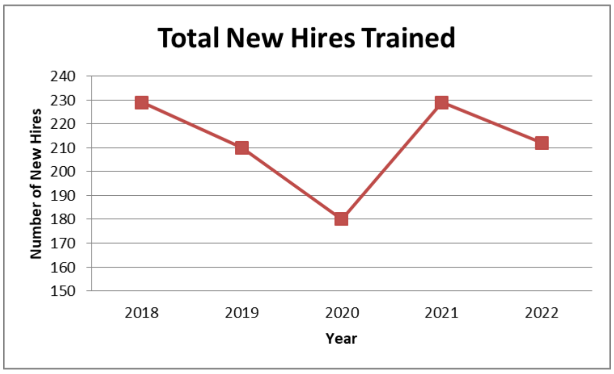

Figure 2

When past observers departed the field with 2-4 years of experience they were replaced by a wave of new hires. 2021 saw the highest number of new observers in recent years (Figure 2) indicating a massive effort went into recruiting and training across the four programs in 2020 and 2021.

According to the *Observer Feedback Survey*, 66% claim that pay is an incentive to stay. Multiple observers also stated they continue observing because other biological science jobs salary simply doesn't compare to the observer salary. 63% are here to aid in protecting marine resources and 57% say that field work and the observer lifestyle are also an attractive attribute and are a factor in their retention. Independent work style was indicated by 43% of observers as a reason to stay. 26% stay because there are no other jobs available and 16% won't be returning upon completion of their current contract.

43% of previous observers left the field for a new job in fisheries management. Consider that 57% of current observers stay to gain field work experience. Observers are taking advantage of the experience this job provides to grow and move onto another fisheries position. 39% indicated that mental health deterioration was a reason they quit. 28% say the pay was not sufficient.

Reasons for leaving for those observers who quit 2018 and after had an increase in safety issues, schedule, mental health, and feeling of inadequate pay. There was also a sharp decline in acquiring fisheries related jobs. This could be due to a couple factors. First, there could be a potential bias in who I could reach in the survey. It is possible that reaching previous observers who left the field for another position would be harder to reach and/or fisheries jobs aren't readily available as they were pre 2018.

This investigation yielded surprising and not so surprising results. Here are some proposed solutions to minimize the observer retention predicament based on results of the survey.

1. Explore solutions to support observers' mental health in and out of the field.

2. Since the majority of observers are here to gain field work experience, NMFS and providers should foster and provide professional development opportunities for quality observers. For example, conference participation, opportunities to contribute to publications, and/or NMFS hook and line/trawl surveys.

3. Create a collaborative platform by observers, for observers to access work information and resources, post questions about vessels for instance, and coordinate informal events to build team morale and maintain camaraderie across port groups. This could be done via the Slack App for example.

NMFS and observer providers must collaborate with current observers to identify and work to ensure the controllable factors of people departing the field are constantly assessed and maintained.

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Observer Peer-Based Mentoring Proposal

Sarah Williamson

North Pacific Observer Program At-Sea Observer (Provider: Saltwater Inc.)

Introduction:

The goal of this program is to provide guidance to new observers and better prepare them for work in the field while also navigating interactions with industry/agencies/and observer providers. Selected observers will increase communication with the Fisheries Management and Analysis division (FMA) regarding areas of confusion or issues for observers sampling in the field. A tech company, Sun Microsystems, found that mentoring programs have increased effectiveness and efficiency. The employees tended to have better performance ratings, retention, and communication skills (Dickson, Gracon, and Jankot pg. 3). Selected observer mentors would help provide a structured supplement to the training by outlining the guidelines and overall objectives of the program. Studies have shown that mentorship programs can assist in increasing diversity and inclusion within the workplace (Beheshti, 1996-2009). The overall outcomes of these programs were positive and the proposed Observer Peer-Based Mentoring Program aims to do the same.

Methodology:

During the 3-week training a list of the approved Mentor Observers (MOs) would be passed out and there would be an option to have a designated observer mentor speak with trainees. Meet ups at observer bunkhouses can be done or have the MO available during a virtual office hour. This provides an opportunity for mentors to be present to answer any questions prior to deployment. This may range from personal gear suggestions, to simple tricks on how to efficiently pack gear, or what extra gear may be helpful.

Short monthly meetings between FMA staff and MOs would highlight common areas of confusion within the observer cadre. Information being relayed by a fellow observer would help minimize confusion and allow someone to bring up areas of concern directly with the FMA division.

The mentors will refer to the manual and tools provided by the North Pacific Observer program as a reference when assisting observer mentees with FMA oversight. Mentors will present themselves in a professional manner with trainees as well as attending any meetings. There will be prerequisite conditions such as having no recent deployment scores of “Did Not Meet Expectations”, experience in multiple fisheries and/or gear types, and, most importantly, the mentors should believe in the goals of the program.

Structuring of the Mentor Program
Selection of observers by FMA or provider
Meeting with new/trainee observers

Meetings with observers deployed since experienced observers may need assistance
Providing feedback to NMFS in scheduled meetings
Providing feedback to providers if necessary

Overall Involvement

Mentor Observer

- 3-5 MOs or more selected from each contractor
- 1 or more available for the meeting with staff
- 1 or more available to be present for 3-week training class
- Update a Google Folder about topics that need to be discussed

FMA Staff

- Help manage an up-to-date Google Document that lists mentors
- Monitor the Google Folder and what is being added by mentors
- Train/guide mentor about involvement in the program and rules

Observer Providers

- Help set up meetings with staff and 3-week trainees
- Recommend potential mentors from their staff

Discussion:

There are major benefits that could come from the observer mentor program. One is bringing awareness of safety to new observers from others who were recently in the field. There would be the possibility for increased data quality with prior observers assisting new observers with practical efficiency, how to utilize observer resources, and how to apply training in the field. The hope would be to improve overall morale and retention. Increased retention is extremely beneficial to the program through keeping experienced observers out in the field and a reduction of resources needed for training new observers. Greater job satisfaction has been a noticeable mentor benefit (Weinberg, et al., 2011).

The observer mentors will benefit by having a unique opportunity to interact with FMA and provider staff. Valuable experience would be gained through facilitating conversation between agencies and contractors. Furthermore, the mentors would be able to assist with career networking for new observers. Generational connections establish a rewarding sense of community and camaraderie in the observer workforce through shared experiences. Professional relationships promote growth and career advancement while increasing positivity within the work environment. Studies in university settings show that mentors and mentees get valuable advice on professional advancement as well as gain constructive feedback (Fountain, et al.,2016).

However, there are some challenges and risks that can arise from mentor programs. Mismatch pairings can happen with mentors that are selected for the new observers. This may cause frustration between a mentor and their mentees. Some might find the other is not helpful or responsive enough (Hansford, et al., 2004). Prior observers and providers could find that the mentors are not fulfilling their job requirements. Clear parameters and expectations will be critical to the success of this program. These kinds of programs need adequate training with distinctly outlined goals to have successful mentees and mentors' relationships (Fountain, et al., 2016). Many studies have shown that mentor programs that lack training lead to problematic outcomes (Hansford, et al., 2004). If this proposed program is approved, then compensation would be another factor to be determined with providers.

The changing landscape of observing over the last few years has put additional stress on the program and its participants. Studies of mentorship programs within universities, companies, and other organizations show positive responses overall. The belief is that this mentor program will provide a better support system for new observers by building stronger relationships with the observer cadre and minimizing issues out in the field. Additionally, it will increase the overall communication between FMA staff, providers, and observers. The proposed Observer Peer-Based Mentorship Program has endless possibilities and will be beneficial to all stakeholders involved.

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Life as an observer: On land and at sea

Jared Sanchez

Frank Orth and Associates, USA

Observing is a challenging occupation that requires a unique mindset and skills in order to succeed. There are many dangers in this line of work, fortunately there is specialized training designed by NOAA.This intends to prepare any individual for the many hardships that can be encountered at sea. It is the responsibility of both the Observer and NOAA to keep the Observer safe when out at sea, but that doesn't only include staying physically safe. Mental health is an important key to the safety and success of an Observer and factors like unchecked stress, anxiety and depression could prove to be detrimental during a trip. Much like the "play" step of the seven steps to survival, trip preparation should also include items that help pass time and reduce any factors that could compromise an observer's mental health.

From personal experience working with Alaskan Observers and Frank Orth and Associates I have worked in multiple fisheries and the commonality between them is that hours can be inconsistent, there is usually no clear schedule, and when out at sea there is uncertainty regarding time of return, especially if there are plenty of fish being caught. These factors can wear down an unprepared observer, this can be avoided with the right mindset and preparedness that some days at sea, or perhaps a trip might not go as well as expected. By conducting interviews with Observers from different companies that work for a variety of fisheries we can learn how to prepare for long periods out at sea and what a successful trip means to each observer who works in the industry. Each observer has their own experiences and coming together and discussing what makes a successful trip work, can be beneficial for NOAA when creating training material for future and current observers.

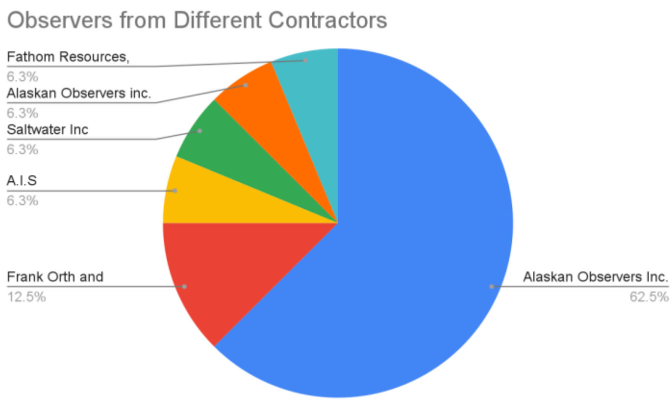


Figure 1 represents a survey take by fellow observers and what companies they work for.

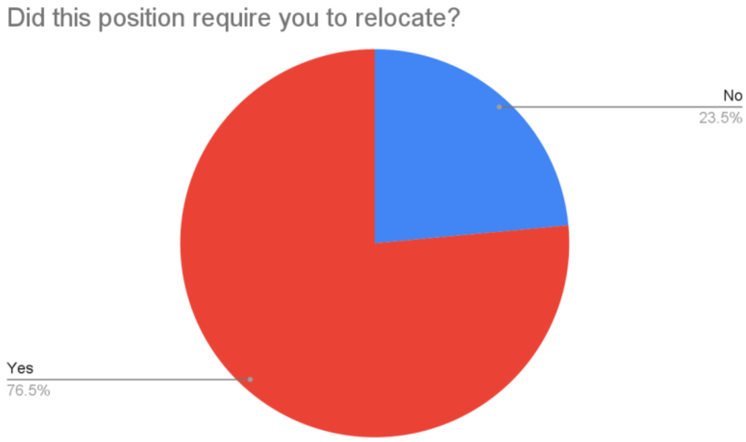


Figure 2. Represents the percentage of observers who relocated for their position.

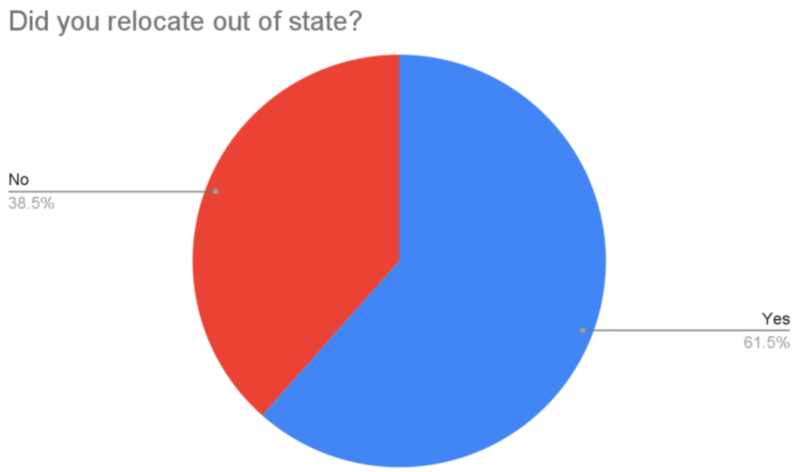


Figure 3. Represents the percentage of Observers who not only relocated, but also relocated out of state.

Abstracts of oral presentations that did not provide Extended Abstracts

Pacific Islands Regional Fisheries Observer Debriefer Operations

Sifa FUKOFUKA

Pacific Community (SPC), New Caledonia

Fisheries observers are the eyes and ears of fisheries science and management. They are responsible for observing, recording, and reporting on the fishing situation in Pacific Island Exclusive Economic Zones (EEZs). This fishery-independent data is imperative, as it serves as the baseline for key policy- and decision-makers.

Debriefing observers play an important role in observer's safety, welfare, and data collection. Observer debriefing provides a process to quickly report and action, if necessary, critical incidents that took place on the trip, give observers timely direct feedback on how they can improve their data, flag data that does not meet the specific quality requirements of data users, give Observer Coordinators feedback on their observer's performance, verify data forms before distributing them to other agencies, explore through questioning, if additional information can be gathered about the trip, judge if the quality of the data has suffered through harassment of the observer, assess the skills and experience for pay and promotion purposes and find out if special consideration is necessary for future placements on that or like vessels.

The prerequisites for taking part in the debriefer trainings include PIRFO experience, excellent communication skills, national programme support, references, and a set number of logged sea days.

Competency Based training method is used in training observers to become debriefers. Debriefing training is in 3 parts, Part A, B & C.

The debriefing of observers is guided by the PIRFO debriefer policy. Observers are required to be debriefed at the end of each trip and if observer is doing a back-to-back trip, at the end of the third trip or 90 sea days, observer must be debriefed.

Open Discussion Session

Phil Ganz to Vanessa Fleming
Q: We talk about observer wellbeing and using social media. But there is a connection between social media and negative mental health. How does the observer programme present an image of what the job is like through social media that portrays a realistic image without causing harm to mental health?
A: There is a misconception that social media in 2023 is about perfection, but it is more like some social media is imperfect, where people can see into someone's life. We need to take advantage of social media to share the true picture. Observers would be the source of images of how filthy conditions are and the tiny bunks and the poor conditions they have to endure along with the pros of the job.

Jody van Niekerk to Jared Sanchez
Q: What do you think we can do to in our programmes to help people with mental health? Should trainers make mental health a more important topic?
A: AOI provided a good response to this issue via an acute scenario in their presentation.

Tiffany Vidal to Rachel Mahler
Q: Are there are examples or thoughts about a hybrid observer programme, with lots of different roles including office work, being at sea, lab work, etc. to improve retention?
A: It has been talked about, mainly involving video review, and it may be beneficial for observers to go back and forth between shore-based tasks and at-sea tasks. Professional development opportunities. Mentorship between a debriefer and an observer.

Craig Faunce to Vanessa Fleming
Q: The session has highlighted the value of observers communicating amongst themselves. There is a benefit to sharing the lifestyle of the observer work. Can you comment on the balance of getting information out there, recruiting and the government desire to maintain confidentiality of at-sea trips?
A: Vanessa Fleming: There are a lot of hoops to jump through. Some have their own social media presence, would need work alongside fishers and industry to get this to work. Regulations may be a block to progressing this sort of work.
Rachel Mahler: The obstacles are passable, but confidentiality etc need to be navigated.
Sifa Fukofuka: Pacific islands have own rules but cannot post any specific information regarding the vessel etc. (similar to US). Aall the programmes are different so consistency on this one is harder.
Sarah Williamson: A clear line of communication regarding the usage of images. always double check before going out on own accord. Government regulations are there to keep fishers and captains happy, but may be changing with newer generations.
Jared Sanchez: captain resistance/captain acceptance - depends on the vessel if they are comfortable with photos being taken

Christa Coleway to Sarah Williamson
Q: You have thought a lot about the mentoring programme. But what would be the logistics of a mentoring programme if people are at sea?

A: Multiple mentors would be needed, to cover those who are at sea, etc. A calendar could be used.

Adriana Myers to Sarah Williamson
Q: First, I want to commend you for this panel, amazing as a trainer to see how the panellists have progressed from when they started. The dedication to the role is impressive. The mentoring programme is a fantastic idea, have you thought about when an observer gets to sea and realizes it's not for them, if they had someone who was a mentor who may be able to help keep them involved and so prevent turnover. How could a mentor help with that? Could you create a toolbox and share what you did to create that?
A: Seen recently that trainers who have been out in the field have experience with the changes that have been occurring in recent years and they have insight in how to prepare new observers who are shocked when they first get out into the field
Training can prepare for anything, but real life is different. Mentors have that real life experience, they could reiterate the training, provide guidance. Having mentors from the start during the training was everything when people were entering the workforce and the observer role.
Having mentors made observing so much easier, some of these mentoring relationships are already existing. A mentor can remind observers that they are not alone.

Debra Duarte to panel
Q: Retention is a multifaceted issue, and I am concerned that part of the issue with retention is that observing is promoted as a stepping stone rather than a permanent career. Could we keep observers longer if it wasn't just entry level and promoted as a career?
A: Rachel Mahler: The candidate pool is new graduates (generally). Yes it is possible but then benefits and other opportunities would be a part of the career itself which is not currently available. Most of time it's just a dead end job, nowhere to grow or move upward as an observer.
Sarah Williamson: Conversations observers have amongst one another has an effect on retention, if one observer speaks up after one contract and not wanting to do another one, a mentor could aid in getting them to at least try another contract. The observer role can be part of a career pathway -> observer -> debriefer -> trainer -> coordinator.

Melanie Rickett to Sarah Williamson
Q: Mentorship doesn't stop after the 3 week training, how do you see it lasting after the initial mentorship, once on vessel, how do you see it working in the long term?
A: New observers were interested in finding someone to speak to, even priors need help sometimes with sampling techniques or how to make the job easier, talking to an actual person, has a longer lasting effect than just speaking through a screen

Steve Kennelly to Sifa Fukofuka
Q: Why is there such a difference from the US observer programmes where retention rates are so much lower than that in the Pacific?
A: Retaining observers is challenging, but the pay incentive is a reason they are able to keep observer retention rates high in the Pacific

Steve Kennelly to Rachel Mahler

Q: You mentioned a desire for observers to be involved in publications, why do you seek things like that?
A:Good to add to resume and if you are contributing to something you should be recognized for it. Observers don't often get the recognition for their work so to be invited to a conference or added into a paper is something that observers like to see since they do so much work but never see the data again

Charles Villifana to Rachel Mahler
Q: Concerning that nationally there is a dip in retention after 2-4 years of observing, now seeing a higher turnover after 1-2 years, but how do we get to a point of retaining those observers?
A: Rachel Mahler New wave of hires right now is high, and retaining them is crucial, so overall observer experience is low as of right now, need to look at data for find out what the actual issue is.
Vanessa Fleming: Small candidate pools and interest is an issue since some of the people who apply for observing, isn't their end goal to be there, its just a stepping stone to something else

Jenny Stahl to Rachel Mahler
Q: important to keep observers engaged in the data for retention purposes, seems at the same time some programs are overloaded or there are funding cuts so there is a push back on special projects, so how do we balance that with keeping observers interested?
A: Over time, give them the opportunity to work with scientists and data analysts, importance of being recognized as a quality observer.

Unidentified to panel
Q: We need to normalise talking about mental health, what do you think we should be doing to make it easier for us to identify at risk observers, some observers may have problems but how can I identify it? Mentorship is also a good idea, something to take home. For example, we pair observers for their first trip.
A: Are they acting differently? Look for behaviours that are out of the ordinary as a guide for someone who may be struggling mentally. Mentorship would be something mainly for those who are on vessels where they are alone.

Poster Presentations - Extended Abstracts

Benefits and challenges of transitioning to electronic entry. Perspectives from the WCGOP debriefing team

Phillip W Bizzell, WCGOP Debriefing Staff

NOAA Fisheries/NWFSC/FOS/West Coast Groundfish Observer Program

Introduction

Over the past five years, the West Coast Groundfish Observer Program has made impressive strides in the design and implementation of our back deck Observer Program Technology Enhanced Collection System or OPTECS. Our transition away from the online paper entry database system (ObsProd) had been in the works for years, but in 2018 we had the first observer trips direct entered into an OPTECS tablet. With each successive version released, we've moved closer to paperless entry by adding functionality and refining the user interface. By 2022 only a select few trips were entered using the legacy database, as shown in figure 1.

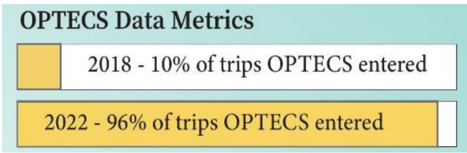


Figure 1. OPTECS vs ObsProd entry 2018 – 2022.

These cumulative changes to data collection were well received by observers and debriefing staff quickly adapted to the new QA/QC checks. The older paper based system required the completion of multiple data sheets per haul and manual catch and species composition weight calculations before entry. Forms would be mailed back and forth for corrections before eventually being archived once the data was closed out. Modified "deck forms" may still be required for some trawl and most fixed gear, rod and reel, or longline trips, but the documentation has been greatly simplified to match OPTECS entry. The overall data collection and QA/QC process, shown in figure 2, has been streamlined from the traditional workflow.

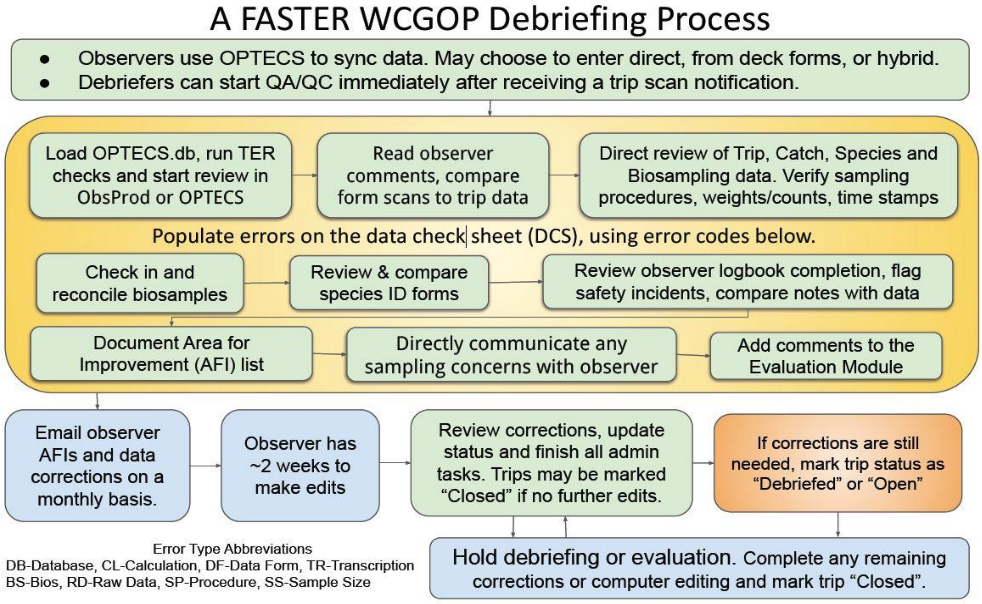


Figure 2. Current WCGOP debriefing scheme.

This resulting debriefing process undeniably became less tedious and time intensive, but was there any measurable effect on data quality? Initially, I planned to compile the number and types of errors for paper data collection vs direct entry for comparison, but it soon became apparent that this wouldn't be possible given the time constraints and limitations of the WCGOP excel sheet based data checking scheme. The few quantitative metrics I was able to use showed improvement, but I needed to rely on the opinions of our experienced group of debriefers for the bulk of my presentation.

This effort will directly influence future development, as a refresh for our legacy database and python based OPTECS software is currently in the works. We're in the process of building out and testing a new progressive web application that will match up a Mongo database with useful OPTECS direct entry data fields like time stamps and keystroke logs. The aim is to develop a modern set of debriefer QA/QC tools that include data visualizations, much better validations, and tracking of data quality metrics.

Methodology

My initial data request included program, fishery, data source, entry method, days to entry, and trip notes for 8347 WCGOP trips made between 2018 and 2022. Data entry method was not collected until mid-2021, so I manually determined this field for approximately 1/3 of the trips from notes and scan file names. These results are listed below in Figure 3.

Entry Method Definitions

Direct Entry: All trip data is collected on the tablet. Data entry occurs on deck in real time.
Hybrid: Some portion of the trip is directly entered and the remainder of the data is collected on deck forms.
Paper Forms: All trip data is collected on deck forms for entry into the OPTECS tablet or desktop version.

Trip ID Count per year by Entry Method					
Entry Method	2018	2019	2020	2021	2022
Direct Entry	90	609	756	874	640
Hybrid	1	5	5	105	548
Forms	2089	1446	420	439	320
Totals	2180	2060	1181	1418	1508

Figure 3. Number of trips by entry method per year.

When days to entry are averaged for each of the entry methods as in figure 4, it shows that data entry time is more than a day faster for OPTECS vs. ObsProd trips regardless of entry method and considerably faster (1.6 days) for direct entry only trips. This leads to more real time updates to IFQ vessel accounts, quicker data closure, and a better experience for new observers.

Days to Entry Comparison						
Entry Method	2018	2019	2020	2021	2022	Average
OPTECS	2.1	2.3	2.8	2.5	2.9	2.7
Direct Entry	0.8	2	2.5	2.3	2.3	2.2
Hybrid	0	2	4	2.3	2.8	2.7
Forms	3	3.3	3.5	3.2	4.7	3.6
ObsProd	3.5	4	4.2	4.7	8.6	3.8

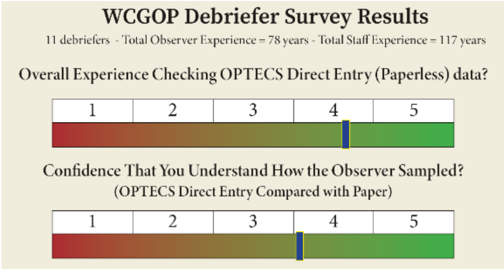
Figure 4. Days to enter/sync a trip for each entry method.

As a program, we have transitioned from completing and managing piles of paperwork and archiving thousands of data forms in 2018 to direct entry or a paper hybrid for approximately 79% of WCGOP trips in 2022. This has sped up the debriefing process and dramatically reduced the cost to print, check, and archive paperwork.

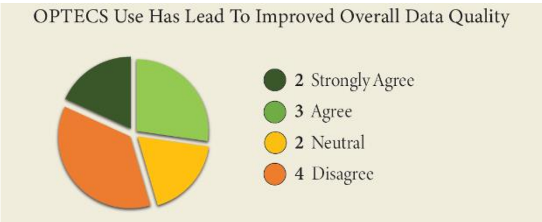
For the remainder of the presentation, I relied on survey results to determine the perceived change in data quality due to the transition to OPTECS and paperless data collection. I surveyed 11 WCGOP staff, who cumulatively have many decades of experience as both observers and debriefers. Questions were a mix of 1 to 5 ratings, agreement scales, and open-ended responses.

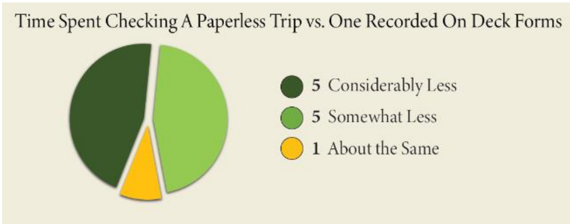
<u>Survey Results</u>

1. Overall what has been your experience checking Direct Entry (paperless) OPTECS data?
    - Very positive - average response 4.2 on a 1 to 5 scale
2. How confident are you when reviewing OPTECS Direct Entered data that you understand how the observer sampled? (compared to paper)
    - More mixed results - average response 3.6 on a 1 to 5 scale



3. Anecdotally OPTECS use has led to an improvement in overall data quality, do you agree?
    a. Mixed response – 45.5% Strongly Agree or Agree, 18.2% Neutral, 36.4% Disagree
4. Do you feel like you spend more or less time checking a paperless trip vs one recorded on deck forms?
    a. Trawl – 10 Considerably less or Somewhat less, 1 About the same
    b. Fixed gear – 9 Considerably less or Somewhat less, 2 About the same





5. In your opinion, what are the main benefits of collecting and debriefing data through the OPTECS tablet? (selected responses)
    - It takes far less time to review for any data entry errors and makes the correction process more streamlined. In general, saves observers and debriefers a great deal of time
    - I notice fewer transcription and math errors. It saves both the observer and debriefer time in the long run. I feel that staff has extra time to spend working on other projects for the benefit of the program.
    - Less land based data effort by observers, less transcription errors, and time stamps help with data integrity.
    - Timestamps have been essential in understanding the workflow on the boat and verifying how the observer sampled.
    - For the observer, it's easier when the trip is over because they don't have to transcribe anything, and they don't have to do any math.
    - Automating calculations was a huge advancement that made everything easier from training to debriefing. There are tremendous time savings for the observer who no longer has to complete paper forms and data entry. The debriefer no longer has to spend time on insignificant forms errors.
    - No calculations. Easier for observers with messy handwriting. Time stamps are very useful in determining out of order hauls.
    - Visually more accurate than paper that could be sometimes difficult to read
    - No paper waste; less land based work for observers improves their quality of life and it likely improves sampling quality.

6. What are the main challenges of collecting and debriefing data through the OPTECS tablet? (Selected Responses)
    - There are issues with tablet responsiveness that I think hamstring the system.
    - Without more built in point of entry data checks transcription errors are hard to fix, observers are far less likely to take notes concerning sampling, and have no way of making diagrams to illustrate how they are sampling.
    - Upkeep of the tablet itself. Limiting transcription errors. (i.e. tablet pen double clicks)
    - Moisture intrusion in tablets. Obtaining and loading OPTECS backup files for QC
    - I wonder if the quality has suffered, as there's no paper trail to check entries. There seems to be a minimizing of their data collection; i.e., they tend to get into a pattern of just doing their 500 lbs then they stop when using the tablet. I'm not as confident that the data is accurate, as I must trust whatever they entered if there's no paper trail.
    - It's easy to make a note on a deck sheet but difficult to make a quick note using the popup keyboard on a tablet. Observers are far less likely to make a note with a question or document a challenge they may have encountered on deck. Over 19 years of debriefing I found deck notes sparked conversation and provided valuable insight that was not provided else wise.
    - It's hard for me to trust that data was entered correctly while on deck, especially in fixed gear.
    - If there is a tablet issue or the observer just didn't know how to enter something, it's often difficult to determine how to correct missing or incorrect data.

7. In the last 5 years, how has OPTECS altered the way you interact with your observers?
   Is there any part of the debriefing process that has been improved or disrupted in a significant way?
    - I feel that I interact less in person with some observers. There isn't a need for them to come by and drop off forms or to do a massive debriefing meeting to correct issues with forms/database. I also complete many of the data edits that I find since there tend to be fewer of them, and the edits are done in a database that's less familiar to the observers.
    - I have had to take less time fixing transcription errors and more time digging into their sampling process. It took a while for me to adjust to the 100% OPTECS entry as I felt the data was more disconnected from the data collection process. I was used to seeing sampling notes everywhere and trawl ally diagrams. Now the way we get observer notes is more consolidated and harder to link to specific hauls in a timely manner. I find I like the OPTECS a lot more with experienced observers than I do with brand new ones.
    - I would say that observer/debriefer data collection/correction interactions have been significantly improved by OPTECS, however, I would also say that the frequency of face-to-face meetings has gone down. I find myself more on the phone or in web meetings, rather than working through observer data

problems in person which may diminish some personal connections and overall personal ownership of data.

- I encourage observers to use whichever method works best for them. Most of mine prefer to use paper on the deck. Debriefing OPTECS trips is easy, but my feeling is that overall quality is negatively affected.
- Almost no shipping of data for corrections for experienced observers is a definite improvement. Significantly less negative feedback; my observers sometimes don't see a data check sheet for months.

Conclusion

There are some drawbacks to direct entry, including most prominently tablet reliability on deck, but WCGOP staff feel positive about the direction the program has taken. Subjectively data quality has improved, although some debriefers admit that face to face interactions have declined and their confidence is not as high when reviewing a paperless trip compared to one with a paper trail. In general, OPTECS has de-emphasized the role of data corrections during observer interactions and led the shift away from more complex data collection methods and documentation. Staff have a healthy skepticism regarding the noticeably fewer corrections, but this is driving the development of new data integrity tools. Overall the switch to OPTECS has resulted in significant time savings for staff and observers and has allowed the program to focus more debriefing time on vessel safety conditions, sampling instruction, and observer mental health and outreach.

Digital Media in Observer Training: Using digital media to teach, recruit, and potentially reduce anxiety and other mental health issues related to observing.

Brad M. Laird

PSMFC, OR/WA Coordinator for the West Coast Groundfish Observer Program (WCGOP)

Fisheries observers start their journey in training. Initial training, as well as recertification briefings for returning observers, are the program's opportunity to provide observers with the best information, tools, and resources available to them. The West Coast Groundfish Observer Program (WCGOP) realizes remaining current with the available tools and resources is paramount. As such, staff are constantly searching for new and more effective methods of training. One tool the WCGOP has recently embraced is the use of digital media. The WCGOP has created a high quality high definition series of in-situ videos. The production of these high quality videos required multiple levels of collaboration amongst observer provider companies, several departments of NOAA, PSMFC contractors, as well as cooperation from the industry.

<u>Critical Project Components for Completion:</u>

- Recognition of new technologies and utilization methods
- Capitalization of available observer resources
- Involving experienced observers in the training and mentoring of new and returning seasonal observers
- Cooperation across all invested parties in the fisheries
    - Observer Provider support for the production team
    - Financial support from sponsoring agencies
    - Staff persistence to keep pushing the project
    - Close-knit relationships between F/Vs and the program

The new training video series presents observers taking actual samples of catch across multiple fisheries, each fishery with its own unique sample methods, specimen requirements, and species of fish to identify. This allows the trainees to see fishing operations, normal catches, and different gear types on board different vessels.

<u>Key Highlights Portrayed:</u>

- F/V accommodations and conditions
- Proper collection of bycatch around working machinery and fishermen
- Sorting of bycatch
- Sample size determination based on diversity of bycatch
- Bio-specimen sampling
- Incorporating the use of on-deck electronics (tablets)
- Collecting fishing effort information (logbook data)
- Documenting marine mammal sightings and interactions

The WCGOP is also encouraging the high quality HD video series to be utilized by observer provider companies to recruit new observers. Additionally, the WCGOP has had a noticeable uptake in mental health issues related to being an observer.

New trainee anxieties can lead to:

- High initial deployment attrition rates
- Mental health issues
- Recruiting difficulties
- Increased work hours for staff
- Reduced data quality

It is hoped that by exposing new trainees to what life at sea entails, there will be a reduction in anxiety and other mental health related issues to observing.

Links to videos**:**

Observing on a Nearshore Vessel - https://bcove.video/38qjRSA

Observing on a Shrimp Vessel - https://bcove.video/3x9fzJP

Observing on a Bottom Trawl Vessel - https://bcove.video/3pyyhJw

Observer Life - https://bcove.video/3fSe3F5

The WCGOP currently has another video in production that will be released by Fall 2023 titled, Observing on a LongLine Vessel. The WCGOP also plans to continue building its library of high-quality high-definition in-situ videos to include topics such as, Observer on a Pot Fishing Vessel, Observing on a Dinglebar Vessel, and other niche fisheries that the WCGOP covers.

Abstracts of poster presentations that did not provide Extended Abstracts

Exploring Recruitment and Future Impacts on The North American Observing Program

Katie Gaughan

AIS Inc, United States

The North American Observer Programs are an essential tool to monitor and regulate the commercial fishing activity along the coastlines of the United States. AIS Inc. is an Observer Provider across multiple observer programs on the West and East coasts. As we have observers in fisheries in the Atlantic Ocean, the Pacific Ocean, and the Gulf of Mexico, we are afforded a unique perspective into challenges observers face in each region. Most data on bycatch and interactions with protected marine species are primarily submitted via Fisheries Observers, making this data critical to collect. Fisheries observing is a tough job; not only in terms of the work observers are conducting; taking lengths, bio samples and keeping track of kept and discarded species; but also, the possibly hazardous conditions on deck sampling in rough weather and living somewhat isolated aboard commercial fishing vessels for days to months at sea. Just as this job and lifestyle are difficult, the recruitment process presents its own unique set of challenges. Many candidates are relocating across the country, committing to being away from loved ones for weeks to months with little or no contact, and must acclimate to life at sea. Additionally, each observer program has a few trainings a year, affording limited options to train to become an observer. As the data provided by observers is crucial to fisheries management, there must always be a steady stream of observers entering the field. Within the last year, we have vetted over 10,000 applicants across all the North American Observer Programs! The observer position has many unique challenges and requires a unique recruitment process; we plan to identify these unique challenges in recruitment, explore the difficulties of the observer lifestyle, and ultimately address these challenges for the future of observing.

Session 7. Technology used by observers

Leader: Lesley Hawn

Increasingly, observers rely on technological tools to improve data collection, efficiency, personal safety and other workplace issues. There are lessons to be learned from observer programs about different technology choices, in particular experiences with their integration and the benefits achieved. The focus of this session was on the operational impacts of technology, rather than specific features of the technology itself.

Oral Presentations - Extended Abstracts

New ways to monitor: Using Remotely Piloted Aircraft Systems (RPAS) as an extension of the inspector/observer's eyes.

Viðar Ólason

Icelandic Directorate of Fisheries

Introduction and the saga

Iceland is a volcanic island in the Northeast Atlantic Ocean, which touches the Arctic Circle. The economy of the small nation of 370,000 people has largely been built up by its rich fishing grounds surrounding the island. In the past, many foreign nations caught fish in Icelandic waters and to protect fish stocks from being overfished, Iceland extended its exclusive economic zone. The main implementations were in 1958 when the IEEZ was expanded to 12 miles, then 50 miles in 1972, and lastly to 200 miles in 1975. This expansion of the IEEZ resulted in a conflict with other European nations which accumulated to what is known as the Cod-Wars.

Today, the exclusive economic zone (EEZ) prescribed by the 1982 United Nations Convention on the Law of the Sea, is up to 200 nautical miles from coastline.

Currently, around 1,100 Icelandic vessels and boats catch around 1.1-1.6 million tons of fish annually, which has great economic significance for this small nation.

The fishing industry plays a key role in generating foreign exchange for the Iceland's economy and its export has been by far the largest source of foreign exchange for a long time. Other sectors have grown in this century, such as heavy industry and tourism, which has created more balance in the work force and made Iceland not as reliant on the fishing industry as it once was. In 2007, marine exports fell below 50% for the first time since 1877. None the less, marine exports weigh the most as a single sector, of producing the most exports.

In the light of the importance of the fishing industry for the Icelandic economy, and due to the fact fish stocks didn't seem to be growing despite that Icelanders had full control over their fishing territory, the government took action to maintain fish stocks and a quota system was implemented for most commercial fish stocks in 1984. The quota system has many good advantages, but in its very nature it also has a built-in incentive for discarding. To prevent frequent discarding, a discard ban was implemented in law from the Icelandic parliament in 1996.

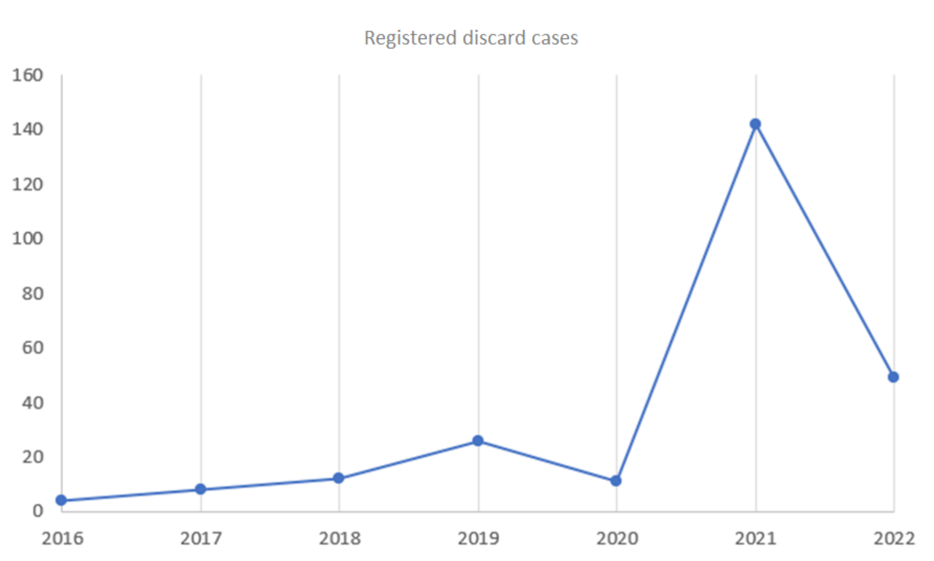
Act no. 57 from 1996 among other things says: *"It is mandatory to land all catch that comes into the fishing gear of a fishing vessel, and no shall be discarded."*

<u>Methodology and motive</u>
Over the years, data collected by the inspectors/observers of the Directorate of Fisheries (DoF) has indicated that the laws set in 1996 are not fully complied with. This is evident when species comparisons are conducted for fishing trips with and without an inspectors/observer and in the so-called discard project that Marine & Freshwater Research Institute (MFRI) and the DoF have been collaborating since 2001. In the discarding project, cod and haddock are length measured from vessel landing then inspector/observer go on a fishing trip with the vessel and measure fishes during the fishing trip. The method is based on the hypothesis that the smaller fishes are thrown and the bigger are not. The difference between these measurements is used to estimate size-dependent discard, this method requires a lot of data and therefore MFRI publishes the results of these projects only every 2 years.

The Food and Agriculture Organization of the United Nations (FAO) has criticized the lack of data on how much catch is thrown away in Iceland. The institute estimates that discards were 10.8% of the global catch between 2010 and 2014. Results of the discard project indicate that discard is around 3-5% in Icelandic waters. Also, in an audit conducted by The Icelandic National Audit Office (INAO) in 2018 of the activities of the DoF, i.e. stated that the agency's monitoring of discards was weak and ineffective, and its actual results were unclear.

In response to that criticism and to implement more efficiency in surveillance, the DoF has been using technology such as telescope and data analysis, in 2020 the DoF introduced the use of RPA´s in the effort to monitor discard. Much work was needed to fulfil rules and regulations concerning data protection and privacy. Following various risk assessments and different licensing obligations, training of pilots commenced.

In the beginning of 2021 DoF flew its first surveillance flight from the coast. At the same time, the number of discard cases increased rapidly or from approx. 10 cases per year to 142 cases by the end of 2021.



Since then, DoF has expanded the application of RPA´s in its MSC duties. DoF pilots have flown from the Coast Guard (ICG) vessels and light boats to reach even further out for monitoring and surveillance practices, covering larger portion of the IEEZ. Flying RPA´s from a vessel complicates the flight process and increases the risk of accidents. However, there has been strong criticism to RPA´s surveillance from owners of smaller vessels that fish close to shore, citing the fact that they get more RPA´s surveillance than larger vessels.

Currently two types of RPA's are in use, a small aircraft of ca. 1 kg. useful for monitoring ports and rivers and an aircraft weighing 9 kg. with a flying range of ca. 3-5 nautical miles out from the coastline.

What we have learned by using RPA´s is that the extent of discarding is more frequent than expected. However, it is difficult to estimate the total quantity based on the data collected with the RPS´s. In 2021, the DoF completed about 800 surveillance and training flights. Discards were observed in approximately 40% of the flights in which fishing vessels were the subject. More flights and scientific studies are needed to estimate the scope of discard with some degree of certainty.

Larger RPA´s

Larger RPA´s with high flight endurance have been tried for surveillance in the IEEZ, by EMSA (*European Maritime Safety Agency)* in collaboration with ICG and with the assistance of DoF. Such devices are subject to a permission from aviation authorities before they go into the air. This type of RPA´s can be extremely useful for monitoring but there are some disadvantages. These are very expensive devices with high operation costs.

To the future

Considering the rapid technological advances in cameras and image analysis, suggestions of decriminalizing discards have been voiced. The idea is that every fish that leaves the vessel will go through image/vision analysis that recognizes species and estimates weight with great accuracy, at the end of a trip this catch is deducted from the vessel's quota like other landed catch.

Developing tools to collect high data quality at sea.

Gasco N., Chazeau C., Martin A.

Muséum national d'Histoire naturelle (MNHN), Laboratoire de Biologie des Organismes et Ecosystèmes Aquatiques (UMR 8067 BOREA), France

Introduction

Patagonian toothfish (*Dissostichus eleginoides*) is targeted by a French fishery around the Kerguelen and Crozet Islands in the Southern Indian Ocean. Seven longliners operate all year round. They catch about 6,000 tons of toothfish per year during 25 trips of 3 months each.

Scientific observers are deployed on 100% of the trips and each year they measure 250,000 fish, tag 6,000 fish and collect 3,000 samples (mainly otoliths). The MNHN is in charge of the scientific observer program for this fishery. To achieve this, we have developed our own guides, technical manuals and standard procedures (Gasco et al 2011, 2015a). The development of the tools to collect data started 20 years ago with a sharp knowledge of the field work but no IT support due to the very small scale of the team working on the data collection for this fishery. This presentation aims at presenting some of those tools, focusing on the ones developed to improve data quality.

Data quality before the trip.

Before they go at sea, observer follow a training session during 7 days. one of the key aspects we have chosen to present here is the learning of the specie's name. Fish guides are very useful for identification but not necessarily sufficient to memorize the species. In order to help observers we have developed a self-training interface which shows a picture of a species for the observer to look at and he has to pick up the correct name in a list on the right. Hundreds of pictures covering fish, birds and invertebrates are available for observers to train for our fishery but this tool can be adapted to any fishery and any taxonomic group without changing the scripts (Gasco et al. 2016, https://www.ccamlr.org/fr/node/92048).

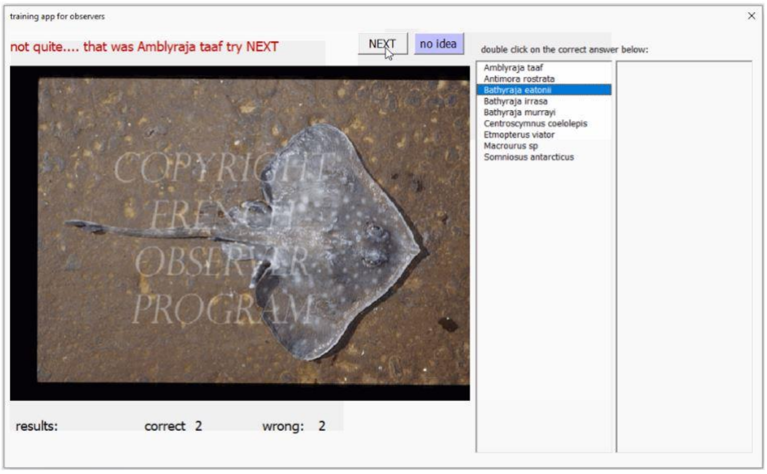


Figure 1. Self-training interface developed for observers to facilitate the learning of the different species.

Thanks to this tool, observers are much better prepared to identify species before they go at sea and see the species for the first time in real conditions.

Data quality during the trip.
All the data collected are entered at sea in an electronic logbook developed in VBA (Visual Basic for Application for Excel), it contains 1089 columns (56 tables in total) covering both skipper and observer's data. Data constraints (integer format, decimal, dates and dropdown menus) were developed to increase quality. Interfaces were developed through Userform to facilitate data entry. This logbook enables the user to export the entire data set in a light passworded file that is sent by email by the observer at sea on a weekly basis to the MNHN to allow double check. Data are then uploaded in the PECHEKER data base (Martin et al. 2021) through an intermediate format called "TCOD".

Because checking data after the trip is not sufficient, we have chosen to develop tools that observers can use at sea on a daily basis in order to allow the correction of discrepancies immediately. The tool we provide has recently switched from a system where all the checking items were coded in a very long script to a system were a much shorter script reads a table (uploaded in the observer logbook) which contains all the checking items, Table 1 gives an example of the structure.

Table 1: example of a two conditions checking item.

	condition 1		Condition 2:		if conditions are met
if	species = Toothfish	&	Total_length > 300 cm	then	The size of the fish is an outlier, please check your notes

1,035 checking items have been developed so far, each of them containing up to 5 conditions. In recent years, a plateau has been reached in the number of items which means almost everything that can be checked is captured by this tool. When a discrepancy is identified, the interface allows the observer to click on a button that takes him directly to the exact location (cell) in the data table that needs to be fixed.

This tool has been developed in VBA as an excel Addin that can be updated and sent to observers at sea by email. New items can be added easily to the list of checkings without writing any script and without computer language knowledge.

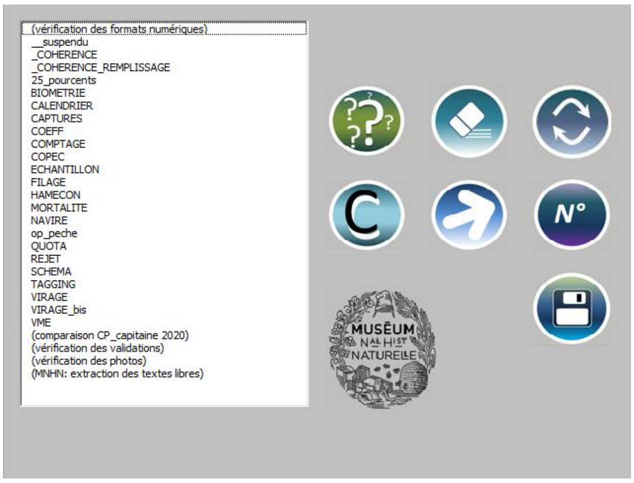


Figure 2. Interface of the checking tools developed in an addin communicating with the French logbook.

Data collected by observers contain many latitudes and longitudes (fishery events and observations). We have developed a map inside of the electronic logbook to visualise start and end of setting/ hauling and observations on the map which is very helpful to identify the position’s consistency. Coastal line and different boundaries (CCAMLR, small scale management units) are also made available along with bathymetry, the user can zoom in and out or display any fishing event in particular.

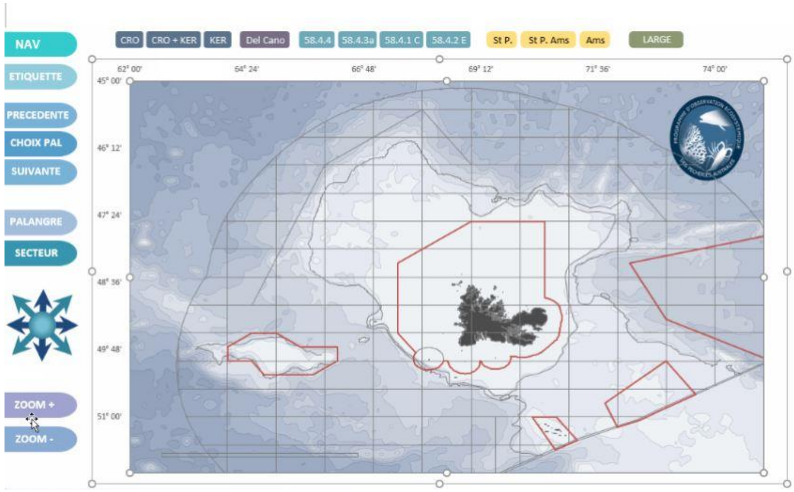


Figure 3. Interactive map as part of the French logbook to visualise fishing events and observations.

<u>Data quality after the trip</u>
Even with the best possible training, one observer might misidentify a species and be consistent on this error for ages, sometimes without any way to know. To be able to detect this and improve data quality we ask our observers to take pictures of all the species they see during a trip and rename the picture with the specie’s name. The observer’s logbook facilitate the naming of the files in a standard way with the use a naming convention (Gasco et al. 2015b).

After the trip we go through all the pictures with an interface developed to archive information on the identifications made by each observer. When an observer goes back to sea on his next trip we extract the data from his last trip and provide a feedback on the identifications he/she made. For incorrect identification a text with tips on how to avoid the confusion between the two species is given.

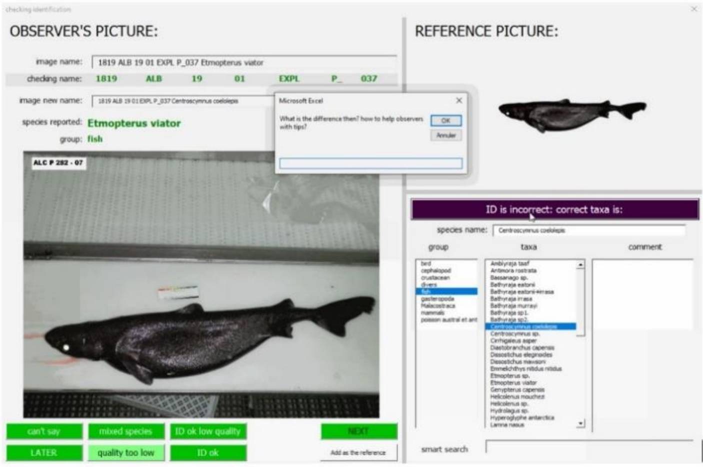


Figure 4. Species validation interface used by technical coordinators after the trip to confirm identification.

<u>Conclusion</u>

Observer must not only be thanked for their incredible work at sea, we must help them to accomplish their task at sea by providing them with user-friendly tools to facilitate learning, entering and checking data. All the files described in this paper are made available here https://doi.org/10.6084/m9.figshare.22188232.v1.

<u>Acknowledgments</u>

We would like to acknowledge the Direction générale des affaires maritimes, de la pêche et de l'aquaculture du Ministère de l'Agriculture et de la Souveraineté Alimentaire and the Muséum national d'Histoire naturelle for support and funding. We are also thankfull to the fishery observers for their work, the TAAF administration, the shipowners and crews involved in the fisheries.

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Abstracts of oral presentations that did not provide Extended Abstracts

Detection and monitoring of fish passing between parallel strip electrodes using electrical impedance measurements

Lukasz Nowak

Wageningen University and Research, Netherlands

Counting fish that pass through an area of interest may provide important data for estimating population abundance. Automated remote fish sensing techniques eliminate the need of engaging significant human resources in the process, and are thus economically efficient and suitable for continuous operation over long periods of time. Their reliability however, expressed in terms of sensitivity and specificity, is often questionable and might strongly depend on environmental conditions. Moreover, different means of detection are prone to various limitations. Understanding the principles of operation is thus crucial for optimizing detection performance. In this regard we investigate the possibilities of using electrical impedance measurements for detecting fish passing between electrodes submerged in water. Electrical impedance is a complex quantity describing the relation between alternating voltage and corresponding current in a specific electric circuit. The method extends and generalizes the concept of resistance measurements. We present results of experimental and numerical investigations on detection characteristics of a fish monitoring system utilizing a set of parallel strip electrodes. We conducted measurements in laboratory conditions, using a glass tank with a single, freely swimming goldfish. A dedicated detection algorithm was used to trigger two cameras recording the corresponding fish positions in two perpendicular planes. The numerical models were used to determine the current density distribution and contribution of each voxel to the overall measured impedance. We investigated how variations in size and spacing of the electrodes determine the achievable signal swing due to the presence of the fish in the detection region and its distance from the electrodes. The close correspondence of experimental and simulation results shows that the numerical model is a useful and efficient tool for designing such an impedance-based fish detection system.

Coordination Between Two US Observer Programs Developing the Onboard Record Collection Application for Longline (ORCA 2) for both the Hawaii and California based Pelagic Longline Fisheries

Charles Villafana

National Oceanic and Atmospheric Administration, United States

The National Marine Fisheries Service operates six regional observer programs throughout the United States. Two of those programs, The West Coast Region Observer Program (WCROP) and the Pacific Islands Region Observer Program (PIROP) observe pelagic longline fisheries in the Pacific Ocean. These fleets operate similarly but under two separate Fishery Management Plans.

Utilizing the Fishery Information System (FIS), Highly Migratory Species Professional Specialty Group (HMS PSG) as the driver of collaboration between the WCROP and PIROP, and using funding from FIS, ORCA is a success story of collaboration across regions and improvement in observer use of technology.

The Deepset Buoy Gear (DSBG) fishery has been in development for the past few years. Along with the authorization of this fishery, the WCROP in partnership with Pacific States Marine Fisheries Commission (PSMFC) and software developer, Resource Data Incorporated (RDI) have developed the Onboard Record Collection Application (ORCA). This electronic reporting system for the DSBG fishery was field tested during the 2021 season and became operational in the 2022 season. This system has improved reporting times, reduced data transcription errors and improved the ability to integrate observer data with logbooks and landings data.

Partway through the development of ORCA for DSBG now known as ORCA1, it became clear that the successful partnership model with PSMFC and RDI was working. This led the WCROP and PIROP to the conclusion that we could further partner to develop ORCA2 for use in the pelagic longline fisheries in both Hawaii and California.

Beginning in 2022 ORCA2 has been under development and early field testing is currently underway. ORCA2 builds on the standardized collections (trip specifications, safety, set and haul, sample) of ORCA1 and incorporates additional longline only data elements.

This presentation will explore the keys to the successful partnership in developing ORCA1 and ORCA2.

Reviews of Back Deck Electronic Data Collection by Fisheries Observers

Woody Venard

Alaskan Observers Inc, United States

How to record data at sea? Paper and pencil, or tablet and software program? What works best in the field? In 2017, the West Coast Groundfish Observer Program (WCGOP) introduced the Observer Program Technology Enhanced Collection System (OPTECS) to observers in order to find the answers to these questions. Instead of recording data on paper while at sea, observers suddenly had the option of using a tablet to record data directly into OPTECS.

Using paper to record data required observers to do all calculations by hand, and additionally enter all data into the database once ashore. Using tablets all calculations are performed automatically by the program, and observers are directed by prompts to collect biological specimens and notified when errors are made. Once ashore, observers can sync the tablet to the database online and transfer data, then their work is nearly complete. This has saved mountains of paperwork, and countless hours of observer and debriefer time.

The introduction of electronic data entry has not been perfect though, and work still needs to be done to assure quality data collection.

A survey was sent to active WCGOP observers. They were asked to rate their experience with both their tablets and OPTECS, identify how they improve data collection, identify common breakdowns and issues, and make suggestions for improvement in the data collection process.

This presentation will cover the results of this survey and provide observer insights in moving forward with paper-less data entry at sea.

Open Discussion Session

Carolyn Umbraco to Woody Venard
Q: When it comes to paper forms (to be replaced by tablets), do you mean duck sheets or "write in the rain" paper? Is there a electronic notebook situation where any water causes malfunctions?
A: The paper is more like plastic. The tablets are just very sensitive to water and sometimes you just have to use sheets.

Jennifer Ferdinand to Lukas Nowak
Q: Do the electrodes detect crustaceans and invertebrates? Has it been tested in the field or just lab conditions?
A: Yes - they should detect invertebrates. It has only been tested in lab conditions.

Tiffany Vidal to Charles Villafana
Q: What are the obstacles for developing a universal software across observer fields?
A: Desire for full control of the product and getting hung up on differences between observer/monitoring programs. Software will eventually be the same platform with the selection of different observable platforms

Bubba Cook to Woody Vernard
Q: How do you determine the economics of different tablet systems?
A: The ones we use are around USD2000 each, hopefully in the future the more durable tablets will be available for a cheaper price.
Charles Villafana - we looked into different characteristics of tablets. Hawaii is testing multiple versions.

Sifa Fukofuka to Woody Vernard
Q: How do you deal with mud/grime debris getting to ports on the devices?
A. Use a stylus to touch the screen to avoid excessing mess on the tablets. It can be very challenging, do the best you can to keep clean. Try to patch some of the openings, trial and error.

Isaac Forster to Vidar Olason
Q: Was it necessary to get permits/permissions for use of drones and dealing with potential interactions with aircraft?
A. If you work with or for the coast guard, you have the license and permits to operate. But fishing vessels are not allowed to do it if the coast guard doesn't give permission.

Unidentified to Vidar Olason
Q: Any issues with battery life? Regulatory hurdles? Any modifications to battery capacity?
A: No we didn't make any modification. We had to go through a lot of process to get the drones in the air. Pilots have to be trained, it was a lot of work. It took a long time to get up and running. No improvement on battery, but may do it in the near future. They can only travel 12 nautical miles. Can complicate flying. Looking into buying a new drone that can go further out. But multi decked boats like trawlers are harder to view with the drone.

Isaac Forster to Charles Villafana
Q: In the Antarctic it’s very cold and wet so instead of a tablet I had a water proof phone and I would press a button to record all my work and dictate what I was doing. Could that work in your fisheries?

A. Woody Venard - it would be great to do in my fishery.
Charles - we tried voice recognition 10-12 years ago but the recorder performed poorly due to some of the words that observers use. There were contractor and user issues.
Steve Kennelly – we used to use taper recorders underwater while diving to record data. A very wet environment! Using the recorder also frees up both hands to measure fish.

Craig Faunce to Charles Villafana
Q: Any consideration for transferring software that can be uploaded to the cloud and then maintained through other services rather than developing new technology to run on static hardware?
A: Charles Villafana: That is our eventual plan to take it there. Our data is being transferred over the internet when you get on land. Get to where it can be updated more regularly. Started exploring android and apple. Windows seemed to be the easiest system to use.
Eric Brasseur - follow up, we are in the process of using a cloud based application, using web progressive apps. All of that is in the plans and should work in the future. It takes time but maybe by next year it will be up and running. Security and data confidentiality can be problems. It takes a while to get approvals and get the study done.
Craig Faunce: as someone that’s work in the government we think we should design the tech ourselves, but the private sectors are more reliable and we should turn to them.

Tanner Rutherford to Lukas Nowak
Q: What is the roadmap and timeline for the electronic detection systems? Are they being designed to be compatible with multiple gear configurations?
A: Don’t have a roadmap or timeline for sea trials. Our goal is to create frame work so it can work. When the opportunity arrives to get it active in the field we will do that. The research and trials are being developed at a research lab at a university.
Steve Kennelly for Vidar Olason
Q: Can you operate the drones at night?
A: You can but there’s no infra-red camera, we rely on the lights on the boat. But it can be very difficult, I don’t recommend it. The camera is very high definition we can identify fish from a km away.

Glen Chamberlain for Woody Vernard
Q: Are the tablets custom made or off the shelf type products?
A: Custom made with stainless steel. Heavy but sturdy and compact enough to fit in sampling baskets.

Poster Presentations - Extended Abstracts

Fish2Data- A new tool for digital fish measurement and catch registration developed for marine surveys and fisheries monitoring in Norway

Sofie Gundersen, Jan Hinriksson and Tom Williams

Institute of Marine Research, Norway

Electronic measuring boards are an effective tool for fast and accurate registration of fish sampling data that are widely used internationally. The FishMeter electronic fish measuring system developed by Scantrol in close collaboration with the Institute of Marine Research (IMR) was the tool of choice for marine surveys in Norway for more than 20 years and is also employed onboard fishing vessels participating in self-sampling for the Norwegian Reference Fleet program. The IMR has now taken fish measuring technology a step further and have developed a new fish measuring software that can be easily integrated in a variety of fish measuring systems and can also be adapted to different data collection programs. This new software, “Fish2data”, is designed to be used with a tablet computer, along with either electronic or manual measuring devices in the workstation. The Fish2data application and data storage can be run using a local server or can be developed for using with a server on the internet, with both alternatives connected to the workstation by WIFI. The software has been designed specifically with IMR’s own data protocol and monitoring objectives in mind but can be adapted to fit other purposes. For the Reference Fleet program, the IMR has designed two versions of Fish2data (for use with or without an electronic measuring board) that can be used both for biological sampling and detailed catch registration. The goal now is to make the Fish2data software available as open-source for use outside the IMR, with the long term objective that the sharing of this technology will contribute to developing new and innovative solutions accessible to fisheries monitoring programs in all countries. For more information contact helpdesk@hi.no.

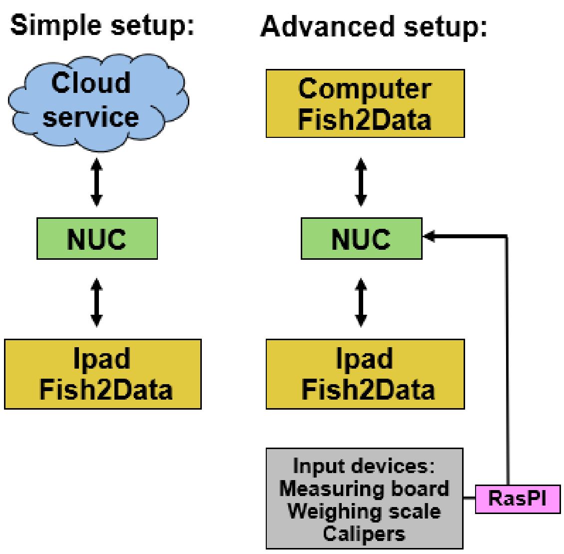


Figure 1. Fish2Data is a web application which can be used both on a computer as well as on an iPad. The system is adaptable to different survey and sampling requirements, where the basis of the system consists of an iPad and a NUC (a small form factor computer used as an

application server). Additional measuring equipment can be added to this setup, such as an electronic measuring board, weighing scales and calipers, using Raspberry PIs (a small budget friendly computer) to facilitate communication between the NUC and measuring devices. The application creates datafiles in the CSV, XML and JSON format, ready to be imported into a database.

Integrated Maritime Services; technology used to monitor fisheries.

Mario Lopes dos Santos, Cristina Morgado, Fabio Carocci, Sven Tahon, Santiago Otero and Justine Jury

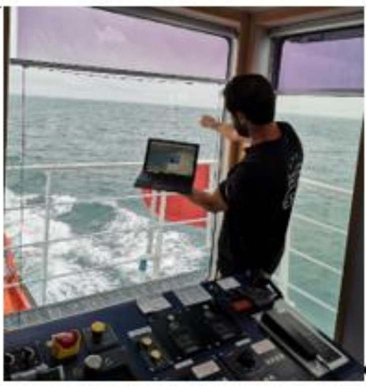
The European Fisheries Control Agency

<u>What is EFCA IMS?</u>

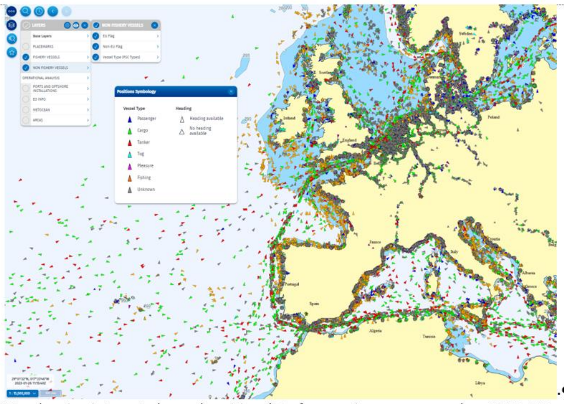
The EFCA (European Fisheries Control Agency) IMS (Integrated Maritime Services) is a web-based application used in support of fisheries control throughout the EU and beyond.
The EFCA IMS integrates and fuses position data in real time collected through different channels such as the Vessel Monitoring System (VMS), terrestrial Automated Identification System (AIS), satellite AIS, long-range identification and tracking (LRIT) as well as Vessel Detection Services (VDS) reports, from satellite images delivered through the Copernicus Maritime Services (CMS).

Today EFCA IMS can cater for various specific fisheries control tasks ranging from day-to-day monitoring of fishing activities, to providing a trustworthy source of worldwide historical vessel movement information for IUU catch certificate verification. It utilises powerful behaviour tracking tools, such as Automated Behaviour Monitoring (ABMs) algorithms which send alerts to the users when vessels of interest behave in certain ways.
The application is hosted by the European Maritime Safety Agency (EMSA) and managed through a long-standing collaboration between the two EU agencies.

EFCA IMS login page



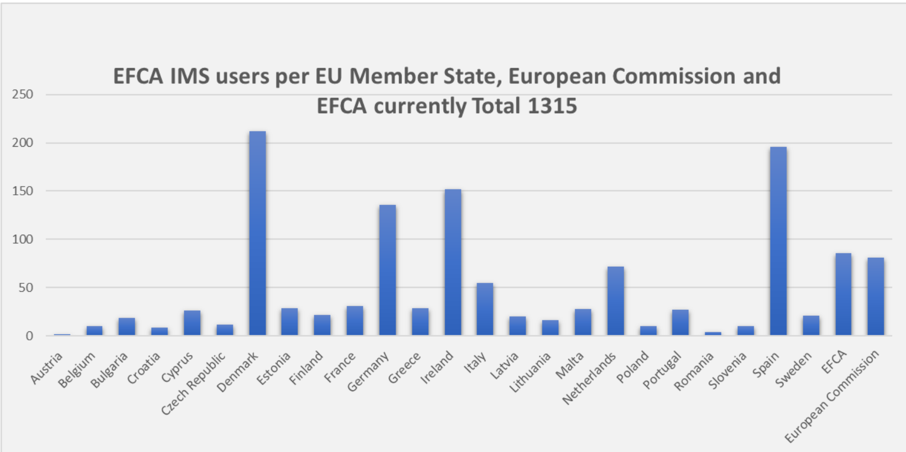
EFCA IMS being used on board an EFCA fisheries patrol vessel



EFCA IMS — showing integrated vessel position data from various sources such as VMS, AIS and LRIT

Who uses EFCA IMS?

EFCA IMS is available for relevant Fisheries control personnel belonging to control authorities of European Member States, EFCA and European Commission. As the information held regarding fishing activities may be commercially sensitive, the EFCA manages users through a rigorous access management procedure. Currently there are 1315 active EFCA IMS users.



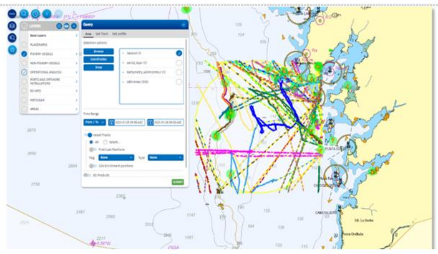
Fisheries inspectors boarding fishing vessels for inspection. EFCA IMS is used to target inspections.

How does EFCA IMS support Fisheries Monitoring, Control and Surveillance?

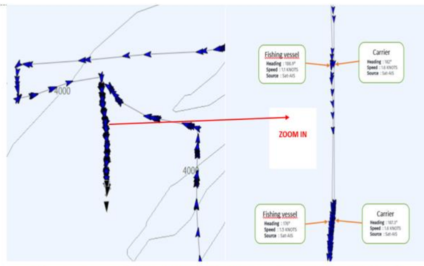
FCA IMS is used on a daily basis by fisheries controllers throughout the EU as a key tool to build up a situational awareness picture and, ultimately to support the detection of suspected fisheries infringements. It is used to identify current and historical fishing activity of EU and relevant third country vessels, for example, to detect if they are operating illegally in restricted areas or are involved in unauthorised encounters with other vessels at sea which may indicate illegal transhipment of catches. EFCA IMS is used by EFCA and EU Member State for tactical deployment of fisheries patrol assets, such as to direct patrol vessels to an area and to select fishing vessels to be inspected as priority, or to direct surveillance aircrafts or RPAS to the area to monitor activity and gather more information.

- Tracking fishing vessels globally

EFCA IMS integrates a huge amount of vessel positional data, from a multitude of sources. This includes VMS data from European fishing vessels over 12m length, which are obliged to send VMS positions to their EU flag state authorities at least every 2 hours, wherever they may be operating. In addition, validated AIS data of vessels in EU and adjacent third country waters are made available by the relevant maritime authorities of the flag state. The AIS data are enriched with a worldwide Sat-AIS and T-AIS data feed procured by EMSA from a multitude of service providers. The integration of the data in IMS provides high frequency positioning information for fishing and associated vessels on a worldwide scale.



Fishing vessel tracks in EFCA IMS displayed in area of interest

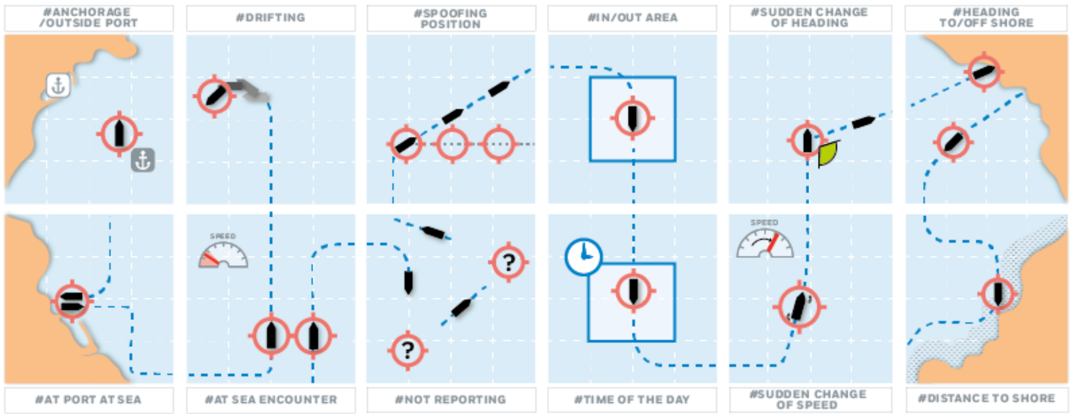


Vessel tracks in EFCA IMS for the detection of transhipment activity

- Automated Behaviour Monitoring algorithms (ABMs)

An ABM is a tool within IMS which can be set by the authorised user to generate alerts when vessels of interest behave in certain ways. The alerts are received by email and visualised in the IMS interface. There are a multitude of types of behaviour which an ABM can be programmed to detect, for example a vessel operating at fishing speed in an area closed to fishing, a fishing vessel involved in an at sea encounter with another vessel indicating possible illegal transhipment of catch, or a vessel leaving an anchor point indicating the start of a trip.

Testimony from an EFCA IMS user of an EU Member State control authority regarding the ABMs programmed by EFCA to control the prohibition of certain fishing activity in areas designated to protect Vulnerable Marine Ecosystems (VMEs) in the Northeast Atlantic: *'From the ABMs EFCA set up in IMS we receive around 20 alerts per week – when they relate to non-compliance we conduct the appropriate follow up.' 'The alerts are working really well and are very useful to guide our control activities'.*

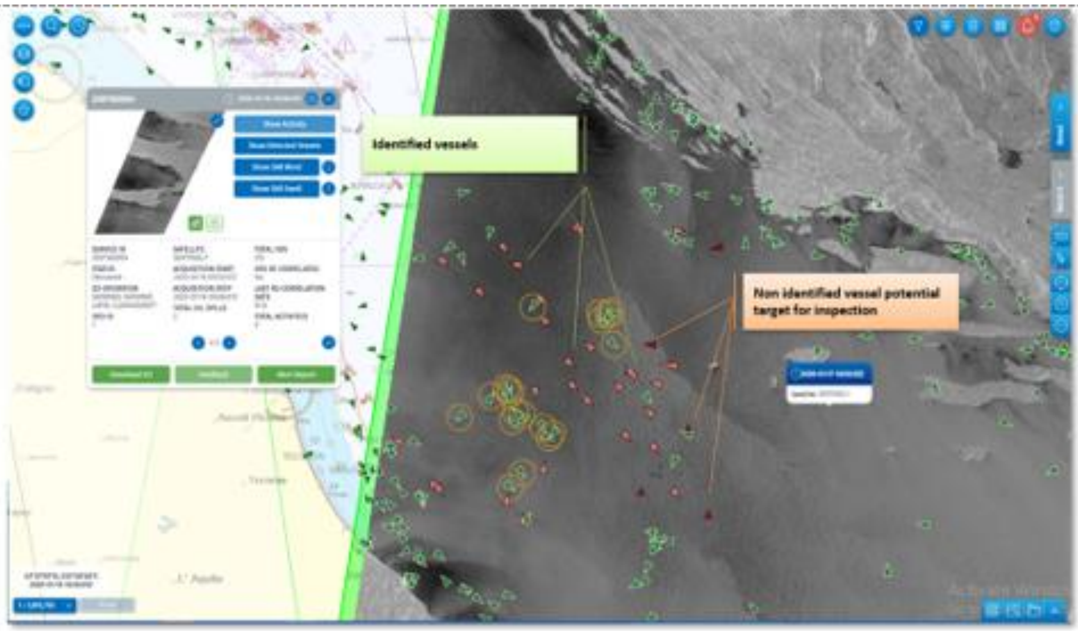


The different types of ABMs available in EFCA IMS (infographic by EMSA)

- Satellite imagery and Vessel Detection Services (VDS)

The Copernicus Maritime Surveillance service (CMS) offers support to the fisheries control user community by providing global satellite imagery services and as such a cost-efficient surveillance capacity, particularly for very remote and large areas. The acquisition of SAR (Synthetic Aperture Radar) and High-Resolution optical imagery for fisheries control purposes is managed by EFCA through service orders transmitted to EMSA. These images are integrated into the EFCA IMS. An automatic VDS algorithm is applied which crosschecks vessels identified in the satellite imagery with position data received in the EFCA IMS (AIS, VMS, etc). The vessels for which no match can be made are highlighted and may potentially be so called 'dark vessels'.

CMS can provide support ranging from a single image to the monitoring of large areas over several months. If needed, some services can be delivered in near-real-time to the end users (i.e., 30 minutes after satellite overpass) or with enhanced fisheries specific analysis by EFCA.



Satellite images with VDS displayed in EFCA IMS

Improving Electronic Reporting with Progressive Web Applications

Neil B. Riley

NOAA Fisheries, Northwest Fisheries Science Center

Introduction

The West Coast Groundfish Observer Program (WCGOP) developed the Observer Trip Selection (OTS) web application to streamline the trip-by-trip selection workflow for observer coverage on vessels participating in the Electronic Monitoring EFP's. Leveraging progressive web application (PWA) and an Application Programming Interface (API), fishers access a simple web application to log trip activity, determine observer requirements and generate unique trip numbers from their smartphones. The reporting efficiencies for both the agency and industry could be significantly improved with an automated system and how this system has evolved into a foundation for generating unique trip identifiers.

Timeline

- In 2011, the West Coast Limited Entry trawl fishery was rationalized as a Catch Share (CS) program.
- Vessels require 100% catch monitoring observer coverage tracking the discarded bycatch and manage in-season quota.
- In 2015, Electronic Monitoring (EM) approved for catch monitoring under an Exempted Fishing Permits (EFP) for vessels participating in the CS program.
- The EFP allows vessels to carry EM equipment in lieu of a human observer.
- The WCGOP deploys observers on approximately 30% of EM trips to collect critical protected species and biological data.
- 2018 Fishing Information Systems (FIS) funding to develop the PWA.
- 2024 EM Third Party Provider regulatory program begins.

Discussion

"The Problem"

- Vessel personnel must contact the WCGOP coordinating staff before every trip to determine if selected to carry an observer.
- The EM observer request process is time consuming requiring staff to be on-call 24 hours a day, seven days a week.
- EM observer requests typically require multiple calls for one trip.
- Under the EM Third Party Regulatory program, the call burden on program staff is not sustainable.

Solutions

- FIS funding provided opportunity to create the application.
- Captain receives immediate notification of observer requirements.
- Logging trip activity into the PWA reduces call burden on staff approximately 70%.
- Unique trip identifier will improve ability to track activity and the life cycle of trip data.

Future Opportunities

- Expand the application to include other WCGOP observed fisheries beyond Electronic Monitoring.
- Convert OPTECS paperless data collection app from Python to a PWA.
- The NWFSC developers collaborated with Office of Law Enforcement develop a “Declarations” application that vessel operators may use to declare in or out of a fishery. Eliminating the need to make a phone call.

Enhancing the Onboard Record Collection Application (ORCA) by implementing RFID technology to track gear related to the newly developed deep-set buoy gear fishery, targeting swordfish off the U.S. West Coast. An Electronic Reporting (ER) Project.

Jody Van Niekerk[1], Charles Villafana[2]

[1]Pacific States Marine Fisheries Commission (PSMFC) and National Oceanic and [2]Atmospheric Administration (NOAA) – National Marine Fisheries Service (NMFS)

Introduction

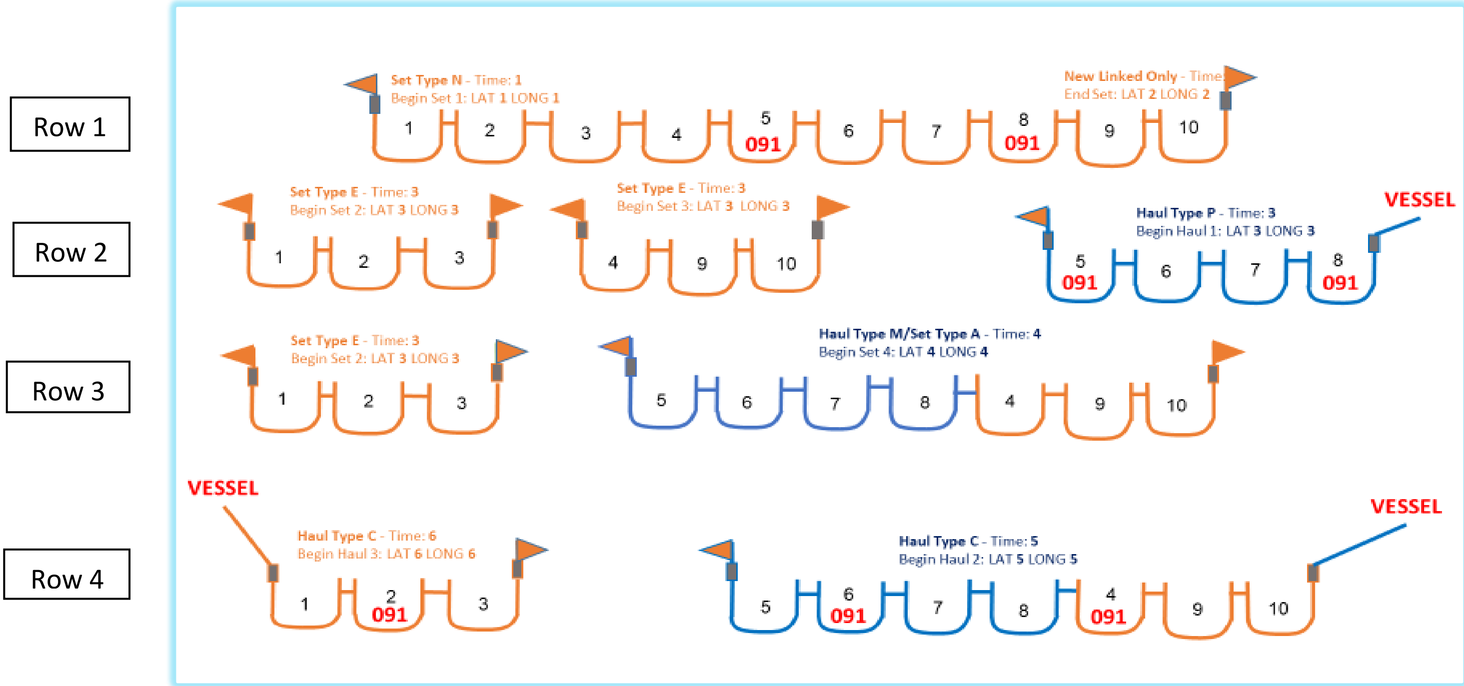
Over the past several years the West Coast Region Observer Program (WCROP) has been at the forefront in developing a newly conceived fishery targeting the U.S. West Coast swordfish stock. The deep-set buoy gear (DSBG) fishery. This fishery uses 2 unique methods to target swordfish, standard deep-set buoy gear (SDSBG) and linked deep set buoy gear (LDSBG).

Utilizing funding from Fishery Information System (FIS) and expertise from the Highly Migratory Species Professional Specialty Group (HMS PSG) to enhance data collection methods, an Onboard Record Collection Application (ORCA) has been developed through the WCROP's partnership with the Pacific States Marine Fisheries Commission (PSMFC) and Resource Data Incorporated (RDI).

This application enables observers to collect fisheries data electronically and as a result, eliminates the use of paper. There are a multitude of other benefits permitted by using electronic reporting, e.g. fewer steps when transferring data from the initial collection method to the database. Data is entered directly into ORCA, after which it is then uploaded to the fishery specific debriefing application.

Discussion

The most challenging gear related data element to collect by observers covering the DSBG fishery, is the tracking of individual or linked buoys in order to accurately associate the set/haul times and positions with a particular piece of gear. This proved to be especially cumbersome for LDSBG, as the gear is not marked and observers need to accurately associate a piece of gear with a catch record, which includes set/haul times and positions facilitated by the application, in order for fisheries managers to determine catch per unit effort (CPUE) estimates.



- The diagram above illustrates just one possible scenario out of a multitude of ways that LDSBG can be "fished". It starts off with the maximum number of allowable pieces of gear set, 10**, row 1**. The gear was designed so the fisher can remove an individual piece, or 2 or more strings of gear, through a serviceable link, depending on where the catch is, without having to haul all the gear pieces simultaneously.
- In **row 2**, catch is present on 2 pieces of gear, 5 and 8, the fisher hauls those pieces including 6 and 7. He re-attaches 4 to 9 and 10, this string of gear is now fishing on its own in one area and the string consisting of pieces 1, 2 and 3 fish in another.
- In **row 3**, he still allows the string made up of 1, 2 and 3 to fish on its own, and re-attaches the string consisting of 5, 6, 7 and 8 to the string consisting of 4, 9 and 10 to fish in a different spot.
- In **row 4**, there is a catch on 2, the fisher hauls the entire string. There is a catch on 6 and 4 and the fisher decides to haul that entire string as well in order to land the catch. Its important to note that with every new string, the sequence of pieces starts back at 1, starting with the piece of gear closest to the vessel. So, the last string hauled in this scenario, would be numbered 1 starting from the right, to 7. Numbers were left as is, so the reader could follow the sequence of events better.

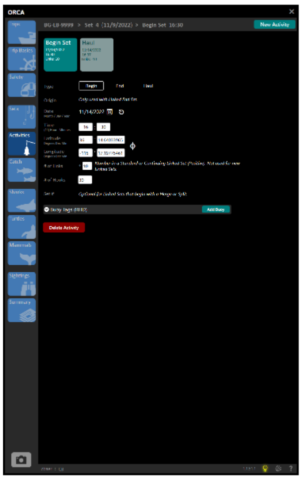
Dell Latitude 7220 Extreme Tablet with ThingMagic USB Pro RFID Reader and Tag. The tags are 100% waterproof and to an extent, crush proof. The Readers are water resistant, as long as no "splash" gets inside the ports. Observers tie the USB cable with cable ties and attach RFID Readers with hook and loop tape to the tablets for more streamlined operations.

Conclusion

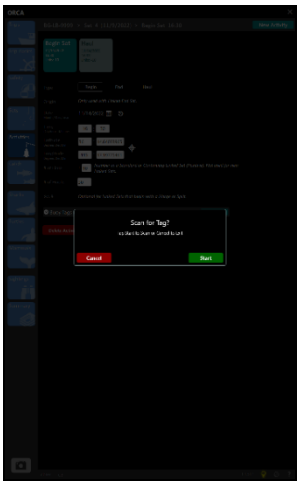
Incorporating Radio Frequency Identification (RFID) technology proved to be the answer, whereby observers affix tags containing unique identifiers in order to mark each piece of gear. RFID readers are then used to read the tags and record the identifiers into ORCA. The observer does not have to stand and spend long hours on deck in order to try and follow each piece of gear, as turbulent seas and the distance the gear may be from the vessel could prevent this entirely.

Due to the fisher having to be at least within 3 nautical miles from the closest piece of gear, an observer has no way of being able to track each piece of gear, as other pieces may be even further out. The tagged gear proved to be a huge relief to observers as they didn't need to be concerned with physically tracking gear anymore.

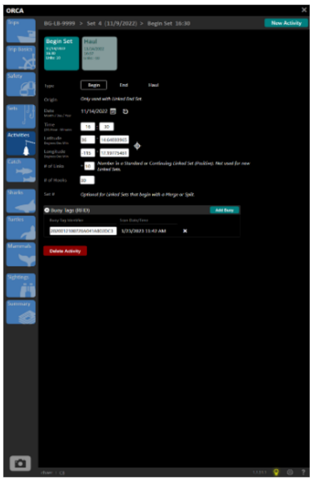
Integrating RFID technology also automates the capture of essential temporal gear related data and the automation greatly reduces potential errors, which occurs when manually trying to identify individual pieces of gear, leaving the observer free to focus on other essential data collection elements, e.g. biological sampling and keeping an eye out for protected species.



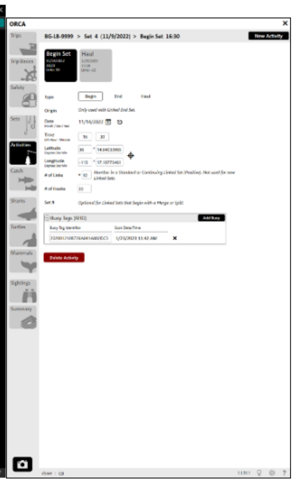
Step 1: The user entered the date/time, position and gear (# of links and hooks) attributes, then selects "Add Buoy".



Step 2: The ORCA app prompts the user to start scanning the tag.



Step 3: The tag is scanned and a unique identifying number is associated with the gear, once again confirming date and time.



This image shows the ORCA application in "light" mode for when an observer works out on deck with full sun exposure.

Acknowledgements

To Cristin Baer and her team at RDI for building ORCA and making sure the RFID technology ingrates seamlessly. Lewis Koplin who was the main observer to test the RFID equipment in the field and gave constructive feedback. Robert Rodriguez for taking photos of the equipment and buoy gear out in the field. Jenny Suter at PIFSC and Robert Ryznar at PSMFC for all their help in purchasing equipment and never-ending support. Charles Villafana for his guidance and help in brainstorming methodologies and always just seeing solutions, never a problem. Scott Casey and Jessica Casey from FOA, for helping me distribute the equipment to observers and being the efficient observer providers that you are and always supporting us in every endeavor.

Abstract of poster presentation that did not provide Extended Abstracts

Electrical impedance measurements for fish detection in fresh and seawater – numerical studies and experimental validation

Lukasz Nowak

Wageningen University and Research, Netherlands

Electrical impedance measurements can potentially be used for fully-automated, cost-effective, remote fish detection in various aquatic environments. They rely on continuous determination of amplitude and phase relations between alternating voltage and current signals passed between a set of submerged electrodes. This approach can be considered as an extension and generalization of the idea underlying operation of the resistivity counters, utilized to estimate fish abundance in running freshwater ecosystems. Electrical properties of tissues making up a body of a fish are different from those characterizing the ambient water. Thus, a fish passing through a volume contributing to electric current flow causes changes in the measured signal. One of the factors determining the range and character of those changes – and thus also the achievable detection performance – is electric current density distribution, which depends on the spatial arrangement of the electrodes. Other parameter, crucial in the same regard, is the electrical impedance contrast between a fish and the surrounding environment. Electrical conductivity of fresh water is one or two orders of magnitude lower than the conductivity of sea water. It is also lower than the conductivity of fish in the former, but higher in the latter case. Those dependencies imply significant differences in possibilities and approaches for detecting fish, depending on the salinity level. In the present study we investigate all of the factors described above using numerical simulations to understand the occurring phenomena, and experimental measurements to validate the results of calculations. We introduce the details of developing finite element models which can be used to derive quantitative values of interest. We consider electrode sets arranged in a single plane – a configuration suitable for shallow running waters and open-water reservoirs, including also fish detection on the seafloor. Potential applications include novel, selective bottom-trawling techniques, with minimized environmental impact.

Session 8. Considerations for the design and application of observer and monitoring programmes

Leader: Amy Martins

Observers or monitoring may not be on every fishing trip, and instead may only be on a subset of the fleet. For the most accurate results, the monitored vessels should be representative of comparable fleet segments, but this is not always the case – especially in fisheries where the act of discarding is illegal, or the cost of fishing is higher on monitored trips. This session focused on defining, categorizing, detecting, and measuring the significance of potential monitoring bias in at-sea monitoring programs and assess whether potential biases can be reduced or eliminated.

Oral Presentations - Extended Abstracts

Increased Monitoring of the Multispecies Fishery in the Northeast United States

Glenn Chamberlain

Fisheries Monitoring Operations Branch, Northeast Fisheries Science Center, National Oceanographic and Atmospheric Administration.

Introduction

In the United States, fishery managers rely on observer programs to generate fishery-dependent data used in many areas of fisheries management. The Northeast multispecies (groundfish) fishery is an important and complex fishery in New England that targets a suite of 13 species (graphic at right). A wide range of vessels participate in the fishery, primarily using trawl, gillnet, and longline gear, and they operate out of both small and major ports. A 2019 analysis on observer effects in the fishery found that fishing behavior was different when a fisheries observer was on board, which suggests that groundfish observer data were not capturing the fishery's "typical" operations. This finding highlighted the need for additional monitoring.

Groundfish Species

The National Oceanic and Atmospheric Administration (NOAA) is responsible for monitoring the multispecies fishery with a mix of at-sea monitors, Northeast Fisheries Observer Program observers, and electronic monitoring (EM). NOAA implemented Amendment 23 to the multispecies fishery management plan during the 2022 fishing year (1/9/2023) to improve the reliability and accountability of catch reporting in the fishery through increased monitoring coverage. This will eliminate the issue of non-representative observer data generated by biased behavior. Accurate catch data are necessary to ensure that catch limits are set at levels that prevent overfishing and to determine if catch limits are exceeded. The new measures will improve documentation of catch and catch accounting by reducing uncertainty and bias. Amendment 23 also gives groundfish vessels the choice to carry an observer or use EM to meet monitoring requirements, providing some flexibility to the industry. Building up to the increased monitoring target comes with a number of challenges. Meeting the target will require cooperation between NOAA, the fishing industry, and the private companies that employ observers.

Methodology

To prepare for the increase in the target coverage rate, the Fishery Monitoring and Research Division (FMRD) of the Northeast Fisheries Science Center (NEFSC) took a project management approach. Staff from three branches of FMRD initiated the project in February 2021. Members of the Fisheries Monitoring Operations (FMO) branch, Training and Data Quality (TDQ) branch, and Data and Information Systems (DIS) branch contributed their expertise to preparing for the increase in coverage. We used past fishing effort to project FMRD's needs, including the amount of gear, trainings, and number of observers we would need.

Since 2010, the target coverage rate has ranged from 14%-40% (table at right). For fishing years prior to the 2022 groundfish year, the target coverage rate was determined by an analysis conducted by NOAA. The NOAA Regional Administrator (RA) set the rate at 99% beginning May 1, 2022. This coverage rate was later reduced (11/29/2022) to 80% based on budget constraints.

Realized Coverage by Year

Year	Target Coverage	Realized Coverage
2010	38%	32%
2011	38%	27%
2012	25%	22%
2013	22%	20%
2014	26%	25.7%
2015	24%	19.8%
2016	14%	14.8%
2017	16%	17.3%
2018	15%	14.5%
2019	31%	23.1%
2020	40%	11.6%
2021	40%	32%
2022	*80%	**61%

*revised from 99% target
**not finalized, based on preliminary data

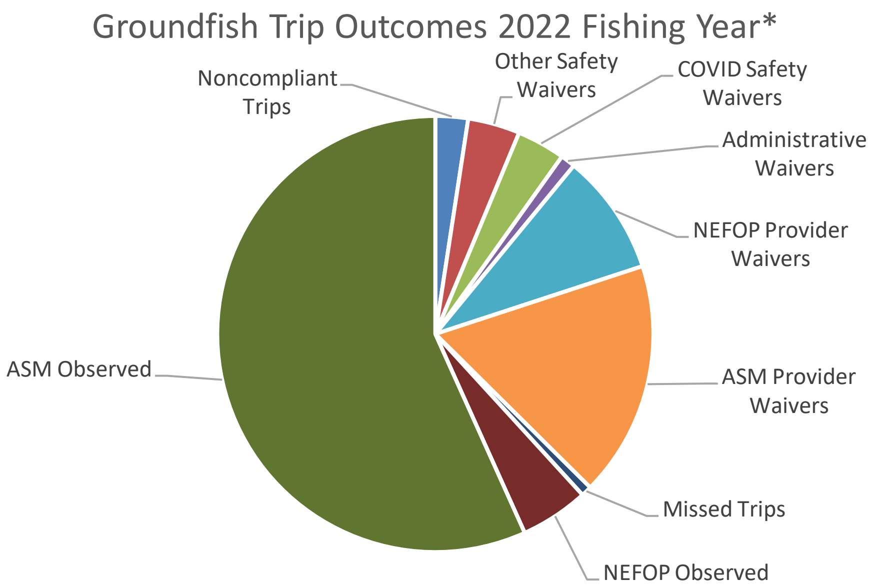
To train a sufficient cadre of observers to reach the target coverage rate, FMRD worked with the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC selected the Coonamessett Farm Foundation (CFF) to train At-sea Monitor (ASM) candidates to at their facility. This allowed FMRD staff to focus on supporting CFF's efforts to train sufficient

ASMs to meet the elevated coverage target while continuing to provide high quality trainings for FMRD's other programs.

Results and Discussion

As of mid-February 2023, the 2022 groundfish year has slightly over 2 months remaining. The fishery's coverage rate is estimated to be 61%, with individual fishing sectors (groups of groundfish vessels) ranging from 32%-88%. To date, CFF has trained 106 ASMs and FMRD has cross-trained a further 13 ASMs since February 2022 over 9 initial and 2 cross training opportunities.

There have been a number of challenges to achieving the coverage, ranging from trips waived due to COVID concerns to noncompliant trips. However, the most impactful challenge to achieving coverage during the initial year of Amendment 23 implementation has been a shortage of trained observers. Across the fleet, greater than 25% of groundfish trips that sailed have not been covered by an observer because an ASM or NEFOP observer was not available to take the trip. This has been an ongoing challenge for all FMRD's at-sea observer programs.



*Preliminary data

In an effort to improve coverage, FMRD staff meet regularly with stakeholders, including industry members and representatives, council members, observer providers, and NOAA staff (science center and regional office). We also support CFF training efforts and reach out to observers regularly to support them. Observer support includes panel discussion during training, listening sessions after training, and individual debriefs in person and over the phone. During regular meetings with industry representatives and providers, we discuss month-to-month trends in coverage for each groundfish sector, work through specific questions and suggestions, and offer solutions to challenges where possible. FMRD staff produce regular and specialized data summaries for end users with as much transparency as possible to facilitate coverage and encourage improvement on the part of all parties involved.

While transitioning the groundfish fleet to higher coverage has been challenging, initial results are encouraging and we hope to build on this success in the future. As coverage of the fleet continues to increase, we anticipate renewed confidence in the data and a healthier fishery in the long term. Looking ahead to future fishing years, we anticipate that coverage will continue to increase by working together with our partners in the fishing industry, observers, observer providers, and NOAA staff.

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Observer Coverage – A review of programmes wordwide and considerations when defining coverage levels.

James Moir Clark,' Joe Chapman

MRAG Ltd.

Introduction

Determining the level of coverage is an important factor when developing or assessing a programme, as is defining exactly what metric is being used to define coverage. This can vary from a broad-scale measurement number of vessels to a measure of effort defined as proportion of days fishing or fishing operations to finer scale, such as number of individuals or proportion of the catch sampled. Often, it is a combination of both. The objectives of the observer programmes can roughly be separated into science and compliance, although most programmes encompass an element of both. This paper concentrates primarily on the scientific coverage requirements and follows on from a number of other studies, reviews and workshops in this area. It is largely based on a previous study undertaken by the MSC by MRAG[5] and summarises the results from that.

Methodology

The report summarised the results of study previously undertaken into levels of observer coverage. The study reviewed previous studies on optimal levels of fisheries observer coverage, considering both the academic and fisheries management literature focusing on research undertaken in the last decade. It also looked at specific differences in what is considered to be an optimal level of observer coverage and briefly discuss the possible reasons for this.

It also assessed what exactly is meant by observer coverage and what levels of are required to achieve the targets of the fishery.

Results and Discussion

At-sea observer programmes provide an independent, relatively cost effective, means of monitoring fishing operations and can be the only reliable source of some types of data required for effective management of a fishery.

However, before considering the level of fishery coverage within a fishery of will important to define or consider what this actually means. There are a number of different metrics for defining this, some are outlined below:

- **Vessel –** Proportion of vessels to be covered by an observer.
- **Trips** – the number of vessel trips that carry an observer.
- **Days** – The number of sea days that are covered by observers.
- **Effort** – The amount of fishing effort that should be covered by observers. This in turn can be defined at different levels such as hauls, trawls, hooks.
- **Catch** – The proportion of catch that should be sampled.

[5] Marine Stewardship Council (2021). Review of optimal levels of observer coverage in fishery monitoring. Consultant report, MRAG Ltd, May 2021.

So if a fishery requires 100% of vessels covered this can in theory have a single observer going between all vessels and spending two days on each vessel. Likewise sampling 10% 10% of all effort may lead to bias if it is all done from one vessel. Sampling effort can even vary between hauls, for example there may be a requirement to monitor every haul for bird interactions but only 50% of hauls for bycatch.

Another consideration will be the management objectives of the fishery. A set of objectives with regards to this were defined at a 2003 NMFS fisheries conference and have been adapted below as:

- catch/effort monitoring for in-season management and/or stock assessment;
- bycatch monitoring for in-season management and/or stock assessment;
- protected, endangered and threatened species monitoring;
- technical monitoring for better understanding of fishing effort and catch per unit effort; and
- compliance monitoring, such as monitoring behaviour in closed areas or during seasonal closures, adherence to MARPOL regulations or compliance with discard bans.
- Crew welfare and safety (not strictly a management objective for a fishery but becoming an increasingly important consideration for fisheries managers).

There have been a number of studies looking at the optimal coverage levels to detect the optimal level of sampling, or the best way to structure a sampling regime given limited resources. Babcock and Piktch (2003) ran a number of simulations, the first looked at the rarity of the species in the bycatch, assuming the fisheries had 1,000 trips. The test was to find at what level they could get to within 10% of the correct value in at least 90% of the simulations, these are shown in Table 1.

The same study looked at the size of the fishery itself (

Table ***2***) in terms of the proportion of samples that would need to be taken to get a 'true' value within 10%. While more samples need to be taken for a larger fleet the proportion is significantly lower.

Table 1 Coverage levels for rarity to detect true levels within 10%.

Total bycatch as percent of total catch plus bycatch	0.1	0.7	6	35.4
Percent coverage to get within 10% of the correct value in at least 90% of simulations	>50	28	18	17

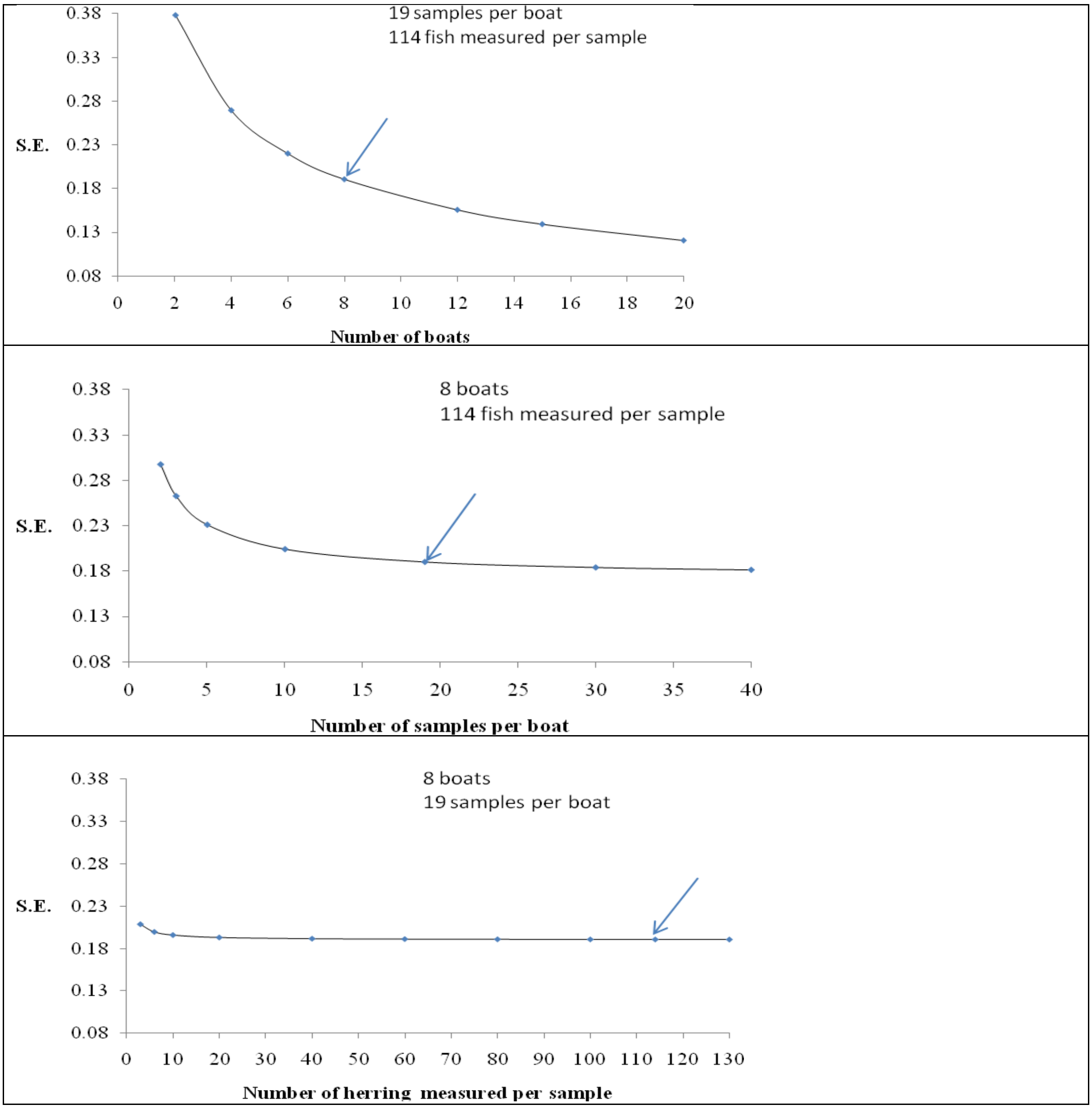
Table 2 Coverage levels for sample size to detect true levels within 10%.

Number of trips in fishery	10,000	1,000	100
Percent coverage to get within 10% of the correct value in at least 90% of simulations	3.6	28	>50
Sample size to get 90% within 10%	360	280	50-100

Another study examined was regarding the target catch and looked at three factors that may influence the true value of the target species (Pennington and Helle (2011)), these were:

- The number of vessels from which samples were taken
- The number of samples taken per vessel
- The number of fish per sample per vessel

The study is based on limited data and is based on vessel self-sampling rather than observer independent data but does still demonstrate various trends. The biggest reduction in standard error occurs when the sampling occurs across a number of different vessels and the number of samples taken per trip.



The advantages and disadvantages of various levels coverage are discussed below, adapted from

Table 3 Levels of observer coverage.

Coverage	Advantages	Disadvantages	Circumstances when rate is appropriate	Reason	Fishery example
No coverage	• No cost • Money saved can be applied to other approaches to monitoring, for example port sampling.	• No observer data • No on-board compliance monitoring	• Fishery has little to no interactions with ETP species and very little habitat and ecosystem impacts.	The footprint of the fishery does not overlap where protected species forage nor does it use gear known to interact with them.	Small-scale beach seine fishery operating in river mouths
Occasiona l coverage (eg **<5 %**) of trips and/or hauls, or specific research programmes .	• Cheap to impleme nt • Provides qualitative information on issues of concern • May provide good estimates of particular parameters in directed research • Easily acceptable to fleet	• Cannot provide robust estimates of fleet-wide parameters. • Unlikely to give precise estimates of ETP species catch.	• Extremely selective gear • Little to no interactions with ETP species and very little habitat and ecosystem impacts. • Low variability in bycatch, if any.	Level of coverage can provide sufficient information to support stock assessments (data on selectivity, fish size, age structure).	Shore-based fisheries operating on land or within view of land.

Partial coverage (e.g. 20% or 30% of all trips, and 10-20% of all hauls)	• Cheaper than 100% coverage • More feasible for smaller vessels • May provide sufficient coverage for routine scientific sampling	• Propensity for differences in vessel behavior between observed and non- observed days • Data may be biased • May not provide enough spatial or temporal coverage • Implementation may be uneven	• Low variability in bycatch. Bycatch commonly found (35% of catch) • Some seabird by-catch. • Gear/habitat interaction.	• Commonly caught species requiring 90% of cases be within 10% of the true value requires 30-40% coverage. • 25% considered adequate to detect increases in seabird bycatch	• U.S. Pacific groundfish trawl fishery commonly catches dover sole and sablefish when untargeted.
50% to total coverage (i.e. observers on 100% of vessels all the time, monitoring between 30% and 70% of effort)	• Good cover for compliance monitoring • Equitable across the fleet • Possible to collect large amounts of data	• May not provide 100% coverage of fishing effort, if not all fishing activity is observed. • True 100% coverage of fishing effort may require more than one observer. • Expensive • May not be feasible to put observers on all vessels • May not be necessary for purely scientific programs • Difficult to get fleet acceptance.	• Rare species bycatch in the fishery (0.1% of catch) • High variability in bycatch • Assess efficacy of mitigation measures. • ETP interactions. • Interactions with a species that occur infrequently. • Assess efficacy of	• When bycatch is a rare event. • Endangered species interactions. • Low levels of mortality could jeopardize the recovery of a ETP species. • Bycatch limitations restrict target species harvest, therefore an incentive exists to underreport bycatch.	• Eastern tropical Pacific tuna purse seine fisheries are managed with individual vessel quotas on dolphin bycatch. • CCAMLR fisheries has move on rules triggered by bycatch.

			mitigation measures		

Final Considerations (adapted from Debski et al. (2016)

- The extent of observer coverage needed to generate robust bycatch estimates varies with the characteristics of the fishery being monitored, species of interest, and bycatch patterns;
- Observer coverage levels of 5% may be adequate to collect information identifying some bycatch risks and issues but is likely insufficient for effectively quantifying seabird bycatch;
- in general, to robustly estimate bycatch levels of more frequently caught species, observer coverage levels of 20% or more may be necessary, whereas to estimate bycatch of species caught infrequently, coverage levels of 50% to almost 100% may be necessary;
- Observer coverage should aim to be maximally representative, taking into consideration factors such as seasonality of fishing, between-vessel variation within a fishery, timing of sets, and location of fishing activities; and,
- Even with high levels of observer coverage there can be unobserved bycatch (i.e. “cryptic” mortality), and this can form a high proportion of total bycatch and can vary substantially between fisheries.

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Methods to speed the transition to electronic direct data collection.

Eric Brasseur

West Coast Groundfish Observer Program, Pacific States Marine Fisheries Commission, Newport, Oregon, USA

Introduction

Transitioning an observer program from paper data collection to direct entry has significant challenges and many considerations, such as: How fast does the transition need to be? Does the current system require ongoing support while the new one is being developed? (Yes!) What are the security considerations? What equipment is best suited for the working conditions and how durable will it be? What software programming languages should be used? What database system? What should the general design be? There are many pathways to a successful electronic reporting tool, from deploying a simpler non-rugged offline entry system for entering paper data at sea instead of on shore, to a fully flushed and tested, rugged on deck direct entry system that can transmit the data at sea or upon return.

Based on my experience with helping to develop the Observer Program Technology Enhanced Collection System (OPTECS) software, there are many steps that can be taken to achieve a quicker rollout, ease transitional issues and improve data quality. If you carefully consider these items you may be able to speed up your program development.

Results and Discussion

A great way to get a head start is to look at other observer programs or fishery independent surveys to find out what they are doing. Ask them what has worked, what has failed and what you may be able to borrow. Some groups have been collecting data electronically for years now, so you may be able to repurpose or build on software, designs, and or concepts they are already using. The West Coast Groundfish Observer Program (WCGOP) for example borrowed the foundation of the OPTECS software from our regions federal trawl survey group and the sync process from our previously internally developed observer program offline system. While this did come with some limitations it allowed us to move to field testing and deployment years sooner than the version we are currently developing from scratch and still have not deployed.

Bring all the stakeholders to the table during the design phase. Including programmers, debriefers, analysts and observers in the process will help everyone get a better understanding of how things should or may work. Look for opportunities to streamline the data collection process. For example, move calculations to the software so the observer only enters the minimum required information. Send surveys to each group designed to get a feel for what they believe would be required for your electronic reporting application to work. Take good notes on ideas and expectations as it may take time to implement them. All together this will help build excitement for the project and give you some insights on how and where to start.

Put together a smaller group to lead the project and give them power to decide how the software will work and what to prioritize. Realize your direct entry system may not look anything like your paper forms. Take your forms apart and work closely with observers to figure out how and when each section should be presented and what level of back and forth movement may be required on each screen. For example data that is collected in a dry clean environment may be easier to enter and can therefore have more detail visible at once, while data collected on deck in a harsh environment may require a lot of dexterity and focus with the need to move back and forth between records quickly. Keep direct entry in mind even if you are developing an intermediate program for transcription based entry as forms can be redesigned to match your new system and allow future growth when you want to move to direct entry or have the funds to get more rugged equipment.

Timelines			
Task	**Sub-Task**	**Suggested Timeline**	**Realistic Timeline**
ER Project-Full		1-2 Years	3-4 Years
Meet stake holders		1-2 Months	2-4 Months
Key Decisions		2-6 Months	4-12 Months
	Programming Language	1-2 Weeks	4 Weeks
	Database Type	1-2 Weeks	4 Weeks
	Security Requirements?	1-2 Months	4 Months
Design Phase 1		2-6 Months	4-12 Months
	Mockup General	4-6 Weeks	6-12 Weeks
	Page Development (Each)	1-2 Weeks	4 Weeks
	Page Testing (Each)	1-4 Days	3-8 Days
Design Phase 2		2-6 Months	4-12 Months
	Mockup General	4-6 Weeks	6-12 Weeks
	Page Development (Each)	1-2 Weeks	4 Weeks
	Page Testing (Each)	1-4 Days	3-8 Days
Section Testing		2-4 Months	1-2 Months

Table 1: An example task list with adjusted timelines. Only a small list of tasks are shown.

Develop realistic timelines then double them. Any project always take longer than expected and there will be delays along the away. You may lose or gain personal, have to refocus staff to other issues, allow for vacations and emergencies, and deal with failures and disagreements. Break development up into smaller chunks that produce testable products on shorter timelines. These smaller tasks will give producible results that can be easily documented in reports for funding requests and help keep development momentum going.

Meet regularly with programmers and assign a few people to work directly with them to quickly answer any questions and test new builds in real time. It builds engagement and speeds up development to have someone extremely knowledgeable of your data collection methods available that can give instant, constructive feedback. This is especially important if the programmers are unfamiliar with working at sea or your observer program's process. Keep in mind that the users may have to wear bulky gloves, handle fish, and hold the device with one hand while using a stylus, all on a moving vessel. Make the software as scalable as possible so it can be displayed correctly on multiple sizes of devices to keep the equipment choices flexible. Build buttons, tables, and menus, dynamically from lookup sets instead of hard coding fields where applicable. This is especially useful for options that may need to be updated in the future and allows the design to be more flexible. Leave complex data validations (on entry error checking) for later after you have confirmed data entry functions as expected. Test and debug the software as you develop each page to ensure it does what you expect. Designing for the environment and catching bugs and misunderstandings early on can greatly speed up development overall. Follow the best programming notation practices possible as you will likely lose and gain programmers as the project goes on.

Addressing data security early on in the process can help speed things up in the long run. Think about your long term goals, even if you will be starting with a smaller project. Having to retroactively add security features can be difficult. One of the simplest ways to add security is to encrypt the database and log files directly. This allows you to back-up the database to a non-encrypted device. If implementing new or unfamiliar technologies, be sure to get all approvals in place prior to development, especially if you intend to migrate from local to cloud storage technologies. Cloud security is becoming increasingly important and many government agencies have complicated processes for approval and stringent requirements on what may or may not be used.

Be sure to answer these questions for your program: What level of security, if any, is required by your institution for how you will handle the data? Is the data to be transmitted over the internet or brought back to the office to download? Will users need to login and if so will it be at the device level, the software level or both? How will users and passwords be managed? Do we need a safe way to back up the data in the field? (Yes and it should be figured out very early on.)

Maximize your effort during the testing phases by having a few seasoned observers collect data on paper and enter it into the new software themselves, either at sea or at home. Ask them to enter the data as if they were collecting it on deck. This can be done with or without ruggedized equipment. Observers will be able to report issues and still have the raw data and learn how the software works. Debriefers will then be able to learn how to review data from both the paper and raw digital files. When the software and equipment is ready this also works as an excellent training method. I recommend continuing paper to device data collection before allowing direct entry until you have worked out all the bugs. This will also help reduce frustration and inform you on how to create training materials and methodologies for the new technology. Initially the time to collect data directly on a device will exceed the time required for paper, until the observer gains confidence with the software and device, but the total time for data collection and entry will go down.

Realistically and financially the equipment should come last. Since the process takes longer than you will expect, by the time you release the software your computer systems could be out of date, or at least out of warranty. Not to mention newer faster technology will be on the market. If you already use non waterproof devices those can often be utilized in the testing phase instead. During the design phase arrange to get evaluation loaner units from any manufacturers that you are interested in. Talk to other programs and try borrow a few units and ask what does and doesn't work for them.

When you are far enough along that you can collect real data and submit it, purchase just a few units to start field tests. You will find bugs with every software release and shortcomings with every computer system, so expect about a year of limited field use as you test and revamp the software and decide on the best equipment for your use case. Once field testing is going well it is time to start getting the bids and ordering the field units. Coordinating the arrival of the bulk of the new computers with a well-tested stable software release will maximize the warranty period and useful life of the devices.

If your budget or time requirements are limited, consider starting with, or using your software as an offline system that will allow observers to enter data in the field or at home after collecting it on paper. These systems can often be designed to mimic the online or local database portal that is currently used by your program, significantly reducing the time between data collection and submission. If your program is small and you have a simple database like MS Access, and you normally have users enter the data themselves at the office, you could just put a blank version of that database on a laptop or tablet and have them transcribe the data at sea in a protected location. When they come back they can bring you a copy of the data to import into the primary database. The lessons learned from field entry of paper data can inform your next step in the process and assist in developing a debriefing protocol. It can be helpful to redesign your forms to mimic how data is collected with a device directly.

To make it easier to debug problems, enforce data integrity pathways and limit the ability to edit data in the field more firmly in the beginning. You will get push back that users want to be able to change things but this step will improve data quality and speed up programming. It's easier to figure out a bug if you can rule out the user changing data after the fact. If your database uses a hierarchical data structure it is very easy to orphan data when top level records are changed. Allow records to be deleted, but only if lower lever data does not exists. It takes time and effort to program the ability to cascade delete and leaving these options available to new users could result in complete data loss. By restricting what users can change and making deleting records difficult, you will be able to deploy and improve the product more rapidly.

Many observer programs at The National Oceanographic and Atmospheric Administration (NOAA) connect via google meet several times a year to stay up to date on what other programs have developed. The meeting is called "The Observer Technology Quarterly Hangouts "and is open to anyone to attend. Please contact me at eric.brasseur@noaa.gov if you are interested in joining the meetings. Some lessons taken away from the group so far: Avoid building your application with all white or black backgrounds as they are hard to read in direct sunlight, gray or mid-range background colors make dark text easier to see. Scrolling is difficult with a stylus and a locked screen. Buttons are easier to use than drop downs menus. Tablets with water touch screen capabilities do not equal salt water touch capabilities, if you work in the salt water environment look for screens that can be locked for a single input device or are pressure sensitive rather than capacitive.

Abstracts of oral presentations that did not provide Extended Abstracts

A Roadmap for Implementing Electronic Monitoring in Regional Fishery Management Organizations

Jamie Gibbon

The Pew Charitable Trusts, United States

Regional fishery management organizations (RFMOs) play a critical role in the management of highly migratory fish stocks whose range spans multiple international jurisdictions and the high seas. To ensure that fishing on this scale is sustainable, RFMOs must be able to supplement their current human observer coverage efforts in order to accurately track accurate information on target catch, bycatch, fishing effort, and compliance with regulations. To help RFMOs close gaps in monitoring and data collection, we present a roadmap, or guidelines, on the key steps, elements, and design choices that fishery managers should consider when designing and implementing an effective electronic monitoring (EM) program in RFMOs. This roadmap specifically focuses on the unique challenges and considerations for RFMO EM program that covers numerous countries, a wide range of vessel sizes, gear types, fishing locations, and catch compositions. The report is aimed at supporting improved management of international fisheries by serving as a resource for stakeholders such as political leaders, staff of RFMOs, government fisheries agencies, and industry members, who are interested in the applicability of EM in RFMO fisheries and the key components involved in developing and implementing a successful EM program.

The PNA Observer Agency Regional Cooperation for Improved Monitoring

Harold Villa and David Byrom

MRAG Asia Pacific, Australia

The Parties to the Nauru Agreement (PNA) Observer Program operates in the vastness of the Western Central Pacific Ocean (WCPO) under the umbrella of the WCPFC Regional Observer Program. The geographic scale of observer operations is probably unrivalled worldwide. Vessels depart and return to a myriad of ports throughout Asia and the Western Pacific with the requirement that all observers be non-nationals of the vessel Flag State, creating unique logistical challenges for observer placements. The fishing covers some of the world’s richest but remotest tuna fishing grounds, primarily undertaken in the waters of Small Island Developing States (SIDS) with limited infrastructure, weak communication networks and infrequent air services.

Scientific Observer data and compliance assessment in CCAMLR

Eldene O'Shea

CCAMLR, Australia

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) undergoes an annual assessment of compliance of all fishing associated activities. This compliance assessment, known as the CCAMLR Compliance Evaluation Procedure (CCEP), applies a data driven assessment methodology which utilises all data available to the CCAMLR Secretariat. Scientific Observer data collected by CCAMLR's observer programme provide critical data and reports on fishing activities within the Convention Area as well as effective implementation of the CCAMLR Scheme of International Scientific Observation (SISO).

Open Discussion Session

Cheng Shi to James Moir Clark
Q: If increasing the number of vessels covered by a program reduces the probability of error, how should that be adjusted if, for example, out of 100 vessels, 10 catch 90% of the quota?
A: Sampling effort should be weighted proportionately, the number of vessels covered reducing error is more about getting a representative sample across the fleet, so any program adopted needs to be able to adapt to accurately reflect how the fleet fishes.

Victor Ngcongo to panel
Q: How do you work out coverage levels for observer programmes and EM programmes? Is it decided by the MSC, the RFMO? Are there clear standards for the at sea observers?
A. Eric Brasseur: Observers and providers should be consulted before implementing EM to determine what is actually wanted, and what works. The approach needs to be changed and EM and ASOPs should not be viewed as an either/or situation.
James Moir Clark: Observer coverage is defined by the fishing effort covered, a metric can be set up to spread coverage amongst vessels combining considerations of proportion of quota and fishing effort.
Jamie Gibbon: Pew's design for how to set up EM in concert with ASOP emphasizes clear objectives, knowing the project's goals. The coverage level or rate covered needs to be clearly defined for an efficient and effective program.

Steve Kennelly to Harold Vilia
Q: What are the logistics of coordinating your programme that covers a large part of the whole planet, given the spread and remote nature of the region, as well as the amount of individual countries, cultures, and languages involved?
A. Satellite phones as well as PLBs, and Garmin inReach are used for logistics and communication, in addition to safety training for observers. InReach devices are loaded with the contact information for port agents of vessels, and coordinators for observers. The closest agent in whatever port the observer lands in can arrange flights/transportation if needed. Sometimes you have observers ending up in South America and then they fly through Asia or Europe and Australia to back to the islands. It's mostly handled by the observer coordinators,
The Ollo application is prioritized for better data access and recording. The common language used is mostly English.

Unidentified to panel
Q: Why do different programs have different platforms for databases (FSCS, Atlas, ORCA, Oasis,etc. Android, Apple, Windows, etc). Vendors should benefit from a standardized platform.
A. Eric Brasseu: Science platforms are created bespoke for the projects, and data has to fit in with past data. The goal is flexibility in programming for different platforms to avoid the issues created when technology ages out and becomes obsolete.
Amy Martins: There is a lot of variation in the resource level allocated for each program to pursue technical solutions and EM. And there are often serious logistical challenges because of security issues and licensing.

Lacey Jeroue to panel
Q: Where is the data loss happening with the tablets?
A: Eric Brasseur Tablets break due to saltwater intrusion, smashed, physically compromised before data can be uploaded or moved, and that's where data loss occurs. It is extremely difficult to extract data from a corrupted or ruined encrypted hard drive. There are some solutions possible, back up data to a cloud platform, an external backup source like an internal memory card (so it's only external in that it can be removed from the device and is a secondary back up to the actual encrypted hard drive of the device itself). Data can also be exported to a flash drive via USB. An automated backup would be ideal. Direct data backups are used in West Coast debriefing processes.
Woody Venard - Using OPTEC and the tablet during observing has been life changing for him in a positive way. How can observers be of assistance in implementing programs like this that streamline their own work flow?
Glenn Chamberlain: Northeast region uses experienced observers as beta testers for new set ups.
Eric Brasseur: Communicate bugs, glitches, and problems are dealt with as quickly as possible. Negative issues are especially important to be reported back to developers. Data is most important, and if that is handled, then the observer can look at error codes. Example from West Coast of issues not being reported where:they had a bar code reader and no one ever used it and it was a waste of money, but we only found out after 2 years of having it that no one used it.
Lewis Koplin - I was one of the first testers of the tablet and it was a nightmare for the first 2 years but now it actually is helpful. The developers and observers had a weekly zoom meeting and the developers were able to push out lots of updates to fix issues as reported.
Amy Martins - Employees of various observer programs are allowed to sit in on observer trainings and it can give them a good idea of how different programs are handling these issues.

Melanie Williamson to Eldene O'Shea
Q: When vessels are out of compliance but working on a solution, how many chances do they get if it is apparent that they are trying to fix the issue? That is, observers communicate with the captain so that they are aware of any compliance issues, but what happens afterward when the observers report non compliance?
A. If a boat is working to fix the issue, they assess how it is happening and if their efforts are working, but really he submits a report to the country that the vessel is flagged out of and they all deal with compliance issues differently. The non-compliance could be treated as a learning experience, or the boat may be penalized legally or financially depending on the country.

Matt Walia to Eldene O'Shea
Q: Are CCAMLR observers specifically trained to talk about compliance issues? Are observers prepped pre-season?
A. Rules may change while an observer is deployed so they may not actually have an accurate idea of what is and isn't a compliance violation. This is not held against the observer. Compliance issues are presented with context, as much information as possible is included. When enforcement gets the report it is a 2 part process, reports are read by multiple people and then discussed, so multiple perspectives on issues are considered.

Jorgen Dalskov to Eric Brasseur
Q: In the EU, standardization of updates to software, control and regulations occurs and the European Commission has developed software which is free to all members and is a very good thing.
A. Uploading and sync causes issues with new data being integrated into existing and old data sets. Some databases were based in Excel etc. Updates can actually break a necessary function of the application. Mongo is used by West Coast which is open source but software needs approval from the federal government and that is difficult. There is a lot of red tape in the USA!

Zane Duncan to Eric Brasseur
Q: Would it be possible for observers to piggyback off vessels' satellite internet and attach their data packets with the vessels' uploads?
A. Eric Brasseur: Not all boats do daily reports in the US and the technology is too expensive for now.
Jennifer Ferdinand: Alaska does use this system on vessels with regular uploads. It is necessary to create an encrypted backup file that is not too large. There are legal restrictions and data rights issues to be considered as well as the size of the export file, but in general it is possible.

Poster Presentations - Extended Abstracts

At-Sea Observers vs. Electronic Monitoring: Weighing the Pros and Cons of Each

S. Phillip Bear

A.I.S. Inc, NOAA Fisheries Galveston Shrimp and Reef Fish Observer Program

Electronic monitoring has been increasingly used to collect data and monitor commercial fisheries. Meanwhile, at-sea observers continue to be used. Each data collection method presents unique challenges, advantages and disadvantages to being implemented on commercial fishing vessels.

The most obvious advantages of using at-sea observers is the ability to collect biological samples such as otoliths, gonads, fin clips, etc. These samples are essential to determine age, growth, maturity, chemical exposure, and DNA. Furthermore, observers can place tags on various organisms to track the movements of tagged individuals.

An observer on a fishing vessel has a greater range of vision and can move about the deck to gain better vantage points to observe wildlife interactions around the vessel. Additionally, fisheries observers would be more accurate in identifying species by being able to closely inspect the catch, especially in situations where different species can only be distinguished by subtle characteristics such as number the of fin spines, color patterns, or other physical traits.

Young greater amberjack (*Seriola dumerili*) (left) is, distinguished from the banded rudderfish (*Seriola zonata*) (right) by the number of dorsal spines (7 vs 8) and the shape of the upper maxillae. Both are only able to be observed with a close inspection.

Deploying at-sea observers is not without its drawbacks when compared to electronic monitoring. Many vessels have extremely limited space on board, and adding a person, along with their sampling equipment and personal items, can further reduce the living and working space on a boat and potentially foment resentment towards the observer, especially if the vessel has to make a trip with one less crew member to accommodate the observer.

Another issue with at-sea observers is that observers cannot monitor all fishing activities all the time, especially when fishing operations occur around the clock. Fisheries observers need to sleep, and many observer providers require that time be taken off to get rest for health and safety reasons. Even when observers are on deck working, they can't see everything happening. For example, while an observer is working on taking measurements and collecting samples from a specimen on a longline vessel, it’s possible that the fishermen could cut the line on a hooked or entangled protected species such as a sea turtle or marine mammal without the observer ever knowing.

The use of electronic monitoring offers several advantages over at-sea observers. As mentioned above, observers can’t monitor fishing activities constantly, but cameras record operations at all times. Cameras could greatly reduce the occurrence of missed captures of protected species.

Another significant advantage to using electronic monitoring is the cameras occupy much less space on board the vessels and are installed in locations that would interfere less with fishing operations than a human observer. In addition to taking up less space, the camera equipment would eliminate the necessity of some vessels to sail with one less crew member to accommodate taking an observer on board.

Electronic monitoring could also be more cost effective for trips where non-fishing activity occupies a significantly higher percentage of the time at sea.

Electronic monitoring equipment (boating.nz.co) (left) and fisheries observer with gear (right)

Like at-sea observers, electronic monitoring has disadvantages. While cameras can monitor at all times, they have a limited field of view and cannot reposition to obtain better vantage points if necessary. A major issue with camera monitoring is the potential for the view to be obstructed by equipment. While camera positioning can reduce this, a significant drawback is the issue of lens obstruction. Sea spray, salt residue, rain, ice accumulation, etc. on the lens can interfere with the cameras ability to view and accurately record the catch. In addition to obstructed views, cameras may not have the resolution for artificial intelligence, algorithims/detectors, or human analysts to properly identify the catch and obtain accurate counts of organisms.

There are also technical problems with the cameras and related equipment. Should an issue occur, it would fall on the fisherman to fix and correct the problem. This would be serious a concern since the monitoring equipment could be in locations that are particularly hazardous to access while the vessel is at sea compared to when it is installed at the dock. Another technical issue is that camera equipment can take time to install and uninstall (1-3) days. This would complicate the deployment process when vessels depart and return with short notice.

Catch from a shrimp trawler (left). Tarp is used to keep catch out of the sun and protect the fishermen from the UV rays that obstructs the camera's view entirely(right).

Some other considerations and factors need to be assessed in determining whether at-sea observers or electronic monitoring would be best. Which method of monitoring is used would be determined by the data most important in that particular fishery. For example, if increased monitoring were required for bottom longliners due to sea turtle interactions, cameras would be sufficient to handle the increased coverage. However, if more data were needed collecting biological samples, such as otoliths, gonads, fin clips, etc., and precise measurements and counts of specimens, deploying at-sea observers would be preferred.

Feasibility of deployment is also a major consideration. The logistics of deploying an observer or sending someone to install, retrieve, and, if necessary, repair the electronic monitoring equipment before and after each trip. The cost and availability of resources and personnel would also need to be assessed to determine what the best method could best be used.

Ideally, both observers and EM monitoring can supplement each other in data collection to allow a complete assessment of the impacts and sustainability of fisheries.

Observers in the Wind – Considerations of observer program impacts from offshore wind development

Amy Sierra Martins

NOAA Fisheries Northeast Fisheries Science Center and School for Marine Science & Technology, University of Massachusetts Dartmouth

Background

Offshore windfarms are planned to be developed in expansive geographic areas (over 22 million acres) that are traditionally valuable fishing grounds in the Northwest Atlantic. As of September 2022, there were 27 offshore wind (OSW) lease areas in the Atlantic Outer Continental Shelf, with additional leases expected in the Gulf of Maine and Central Atlantic (BOEM 2022). OSW has a projected 79% annual growth rate in the US from 2020 to 2030 (Lee *et al.* 2021). The U.S. has an aggressive target to achieve a 50-52 percent reduction from 2005 of greenhouse gas pollution by 2030 to mitigate climate change. The Biden-Harris administration set goals of 30 gigawatts (GW) of offshore wind energy by 2030 and 15 GW of floating offshore wind energy by 2035 to reduce carbon emissions.

At-sea observer data are collected onboard commercial fishing trips and used in setting quotas, estimating stock abundance, and monitoring levels of bycatch (NOAA NEFSC 2020; Wigley et al.). U.S. Northeast (NE) fishery observers collect critical data used for scientific assessments, resource management, ecological and economic impact studies, and biological research of marine ecosystems. The Northeast Fisheries Observer Program (NEFOP) deploys up to 150 observers (with approximately 12,000 seadays) a year on commercial fishing vessels from Maine through North Carolina (ROSA 2021). The foundational premise of NEFOP is that observed trips are representative catch data of fishing trips in a particular sampling stratum (gear type and geographic area) that can be expanded to unobserved trips.

Work Available

NOAA Fisheries evaluates and recommends mitigation of OSW impacts on fisheries-independent surveys (Hare *et al.* 2022) and fisheries-dependent data collections (Hogan et al., 2023). The Responsible Offshore Development Alliance (RODA) prepared a document with the Bureau of Ocean Energy Management (BOEM), and National Marine Fisheries Service (NMFS) Northeast Fisheries Science Center (NEFSC) on Fisheries Dependent Data, summarizing a workshop of 550 participants on their perspective and concerns regarding wind development. The report synthesizes information on ecosystem, socioeconomic, and fisheries management/data collection effects, and methods/approaches for research and monitoring in order to examine how fisheries and fisheries resources interact with offshore wind (NEFSC, 2023). NOAA Fisheries has created a Fishing Footprint tool that allows researchers and managers to select specific wind areas and see which species or ports may be affected in terms of catch and value. To match catch to specific wind areas, scientists utilized a combination of observer and vessel trip report (VTR) data with methods from DePiper 2014. Utilizing both the fishing location from the VTR and the observed haul coordinates can improve spatial models for more sophisticated socioeconomic impact analyses. Allen-Jacobson *et al.* (2022) analyzed the spatial distribution of a fishery to support compensatory mitigation (from OSW developers) at different scales, estimating active-fishing-footprints from fine-scale global positioning system location data collected by NOAA's NEFSC Study Fleet Program (Jones et al.).

OSW developer companies have agreed to compensate fishermen for financial losses – due to increased transit time, damaged gear, or loss of fishing opportunity. A NOAA report, funded by BOEM, characterizes commercial and recreational fishing from Maine to North Carolina and provides insight into revenue generated by federally permitted fishermen (Kirkpatrick *et al.* 2017). The report details the average value of fish harvested over a six-year period between 2007 and 2012 ("exposed revenue") and identifies the ports and fishery sectors (e.g., gear, species) supporting that activity. NOAA also developed a model to estimate the socio-economic impact of wind energy development on commercial fishermen. The report concludes that the ports of New Bedford, MA; Atlantic City, NJ; Cape May, NJ; and Narragansett, RI, are the most exposed to potential impacts from wind energy development in terms of total revenue. By total value, sea scallops are the single most exposed species at an average annual $4.3 million in revenue sourced from the potential wind energy areas, but this value only represents one percent of the total scallop landings along the Atlantic. The results generally indicate that commercial fisheries are expected to be minimally impacted due to availability of alternative fishing areas. The issue of scale and commonly applied frameworks would help to categorize, standardize, and quantify scientific data that could be used to address the concerns of windfarms and fisheries. By looking at various existing frameworks in resource management, an ecosystem approach and multidimensional matrix to organize goals and objectives has been suggested (Stokesbury *et al.* 2022).

<u>Recommendations</u>

With potentially large-scale impacts on the physical and biological systems of the ocean, and socioeconomic impacts on fisheries, observer data are critically important to detect changes during and after OSW development. Observer programs should emphasize the collection of the economic information; re-evaluate the data collection and training on weather, wave height, wind speed, and water temperature; consider adding opportunistic seabird, sea turtle, and marine mammal sightings. Observers should be prepared to comment and report on gear conflicts, increased transit time, and changes in fishing operations and where catch was expected, through fishermen comments. Presentations should be developed to include as part of observer training to build awareness around where the turbines will be and what impacts are of concern.

Windfarm developers, regulators, scientists, engineers, academia, and ocean stakeholders must work together to achieve common objectives of clean renewable energy and a healthy marine environment.

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Discard and bycatch monitoring program at industrial demersal fisheries in Chile: Where we are eight years from its implementation?

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Background

Discard and bycatch have been a problem in world fisheries. Considering the significant decreases in fish landing as of 1995 and increasing of stocks overfished, during 2012, modifications on the Chilean Fisheries Law with an ecosystem approach, including a permanent discard and bycatch research monitoring program (DBRMP) through scientific observers on-board in fisheries, were established to know and address this problem (San Martín et al., 2016; Román et al., 2021). The main objectives of this monitoring program included the determination of levels of discards in each fishery, quantify bycatch (marine mammals, seabirds and marine turtles) and identify the causes. Results obtained by DBRMP have been key to implement the mandatory reduction measures to reduce the levels of discard and bycatch at industrial demersal fisheries in Chile.

Monitoring approach

With the aim of showing the steps and evolution of this process, indicators of discard and bycatch at demersal industrial fisheries between 2013 and 2020 years were assessed. A total of ten industrial fisheries, distributed from 28°S to 57°S, including longline and trawling gear were considered (Figure 1). Additionally, a summary of main regulatory measures were identified.

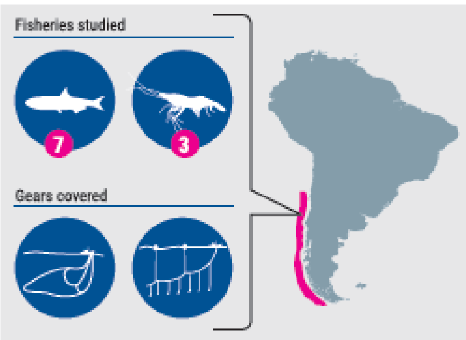

Figure 1. Chilean industrial demersal fisheries studied and spatial coverage.

Results

The results showed that the involvement of fishermen was an important element to ensure the success of DBRMP and development of discard reduction plans. One of the biggest challenges to start the DBRMP was to achieve the engagement of them in a participatory process. Thus, meetings were held to provide information outreach about the law and DBRMP. After eight years from the beginning of the DBRMP, important improvements have been observed. Discard in trawling fisheries showed variations in period evaluated, but in general decreased on average 70% respect to initial values. The same trend was observed in long-line fisheries, dropping around 60% with respect to the first years (Figure 2 A). Similar trend was observed regarding bycatch of seabirds and sea lions, nonetheless, longline fisheries have not registered bycatch of marine mammals and bycatch of seabird has been almost absent at crustacean fisheries (Figure 2, B y C).

Four general kinds of causes of discard were identified; regulations, operational, quality and factors associated with commercial issues. The last cause was the most important with factors such as catch of non-commercial species and non-commercial size. Bycatch of sea lions and seabirds were associated with entanglement and when the animals feeding the catch or bait.

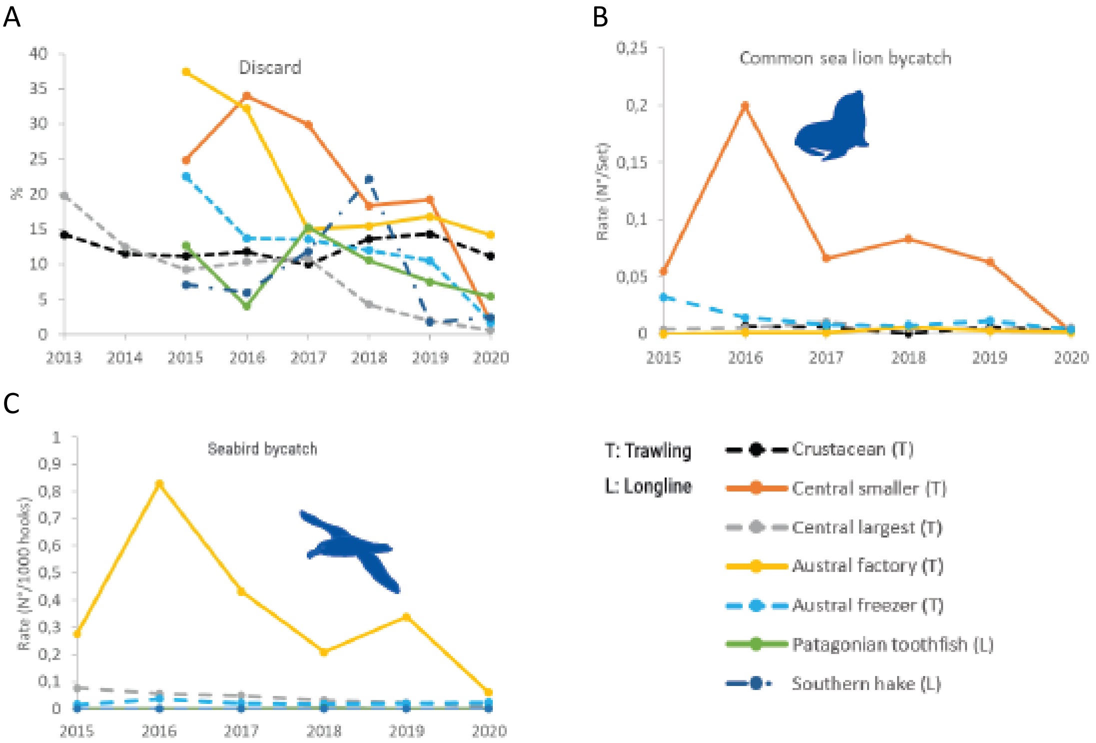

Figure 2. Historical trend of discards and bycatch of sea lions and seabirds in Chilean industrial demersal fisheries.

Discussion

The BDRMP has enabled identification of causes and levels of discard and bycatch in Chilean fisheries. Each fishery has different species composition and levels of interaction with marine mammals and seabirds, consequently its management must be treated specifically. In this line, the BDRMP results helped the Undersecretary of Fisheries to establish reduction regulations and to improve fisheries management in Chile. Among the mandatory measures that have been implemented are; the discard ban of target species, adjustment of the non-target species catch rate, prohibition of bycatch, the mandatory use of bycatch mitigation measures systems as the grid device and tori lines used to avoid sea lions and seabirds. Is important to recognize that the historical evolution of discards and bycatch indicators in demersal fisheries has been favorable, with an important decrease. These results have been influenced by the increase the commitment of industry and fishermen and mandatory reduction measures established. Additionally, inputs delivered by BDRMP have been used to implement the electronic monitoring (EM) on board the industrial fleet by the control and enforcement agency (Sernapesca). Improving the monitoring and management of discards and bycatch in artisanal fisheries is the next step.

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How far are we from eDNA-based biomonitoring of fish? A look at the spatial reach of eDNA in lotic waters.

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<u>Background</u>

Biological monitoring and assessment of (riverine) fish communities is traditionally performed using electrofishing, gill nets or trap nets; generally effort-intensive as well as invasive techniques (Laporte et al., 2020). These methods are in turn limited by taxonomic identification resolution and are frail in the detection of small or elusive species. Environmental DNA (eDNA) is shed from organisms via their epidermis, faeces, mucus, hair or gametes, and can be detected in water samples using PCR assays based on DNA barcoding (Hallam et al., 2021). Lotic biomonitoring of fish fauna using eDNA-based methods could serve as a complementary technique to conventional, invasive, costly and time-consuming methods. Integration of eDNA-based detection methods into existing regulatory monitoring frameworks, however, requires further insights and the development of practical guidelines (Van Driessche et al., 2022). One of the main challenges encompasses uncertain fate determination of an eDNA molecule after its release from the source, i.e. the fish.

<u>Aims and Objectives</u>

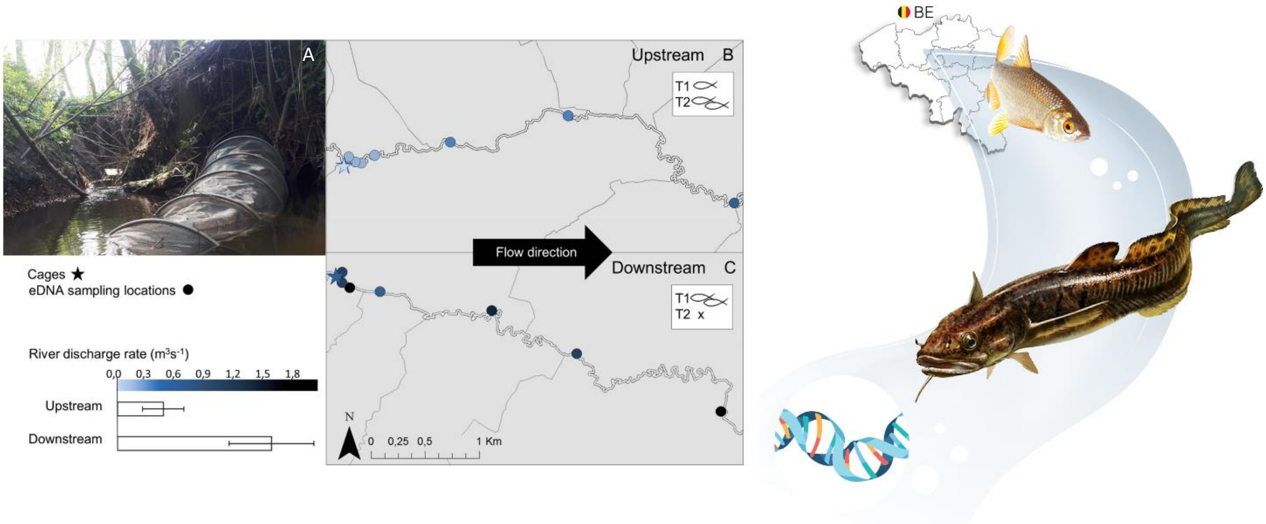
The following objectives were outlined for this project:

- Gain knowledge on the spatial scale at which eDNA patterns can provide information on detection and quantification of upstream fish populations in small river systems, as well as on species-specific dispersal patterns of eDNA and with it, increase understanding of the eDNA “ecology” in relation to lotic water transport properties.
- Investigate the effect of distance from the source, river discharge rate, or amount of biomass at the source on downstream eDNA dispersal patterns, eDNA detection and absolute quantification rate.
- Assess the distance at which eDNA originating from a local multi-species fish community can be detected downstream from its source.
- Compare the relative species abundance estimated by eDNA metabarcoding to the biomass per species in the cage community, to evaluate quantification accuracy and study which of those three studied factors affect the eDNA-biomass correlation (distance from the source, discharge rate or amount of biomass at the source).

<u>Approach</u>

We used a longitudinal cage study in a small Flemish river (Belgium), incorporating both species-specific droplet digital PCR (ddPCR) analyses as well as community-wide screening via eDNA metabarcoding. Therefore, fifteen fish species were held in keepnets (~cages). At varying distances downstream of these cages, water was sampled and filtered for its eDNA. Downstream distances included 25, 50, 100, 300, 1000, 2000 and 4000 m from the cage communities. Sampling was initiated at the furthest downstream distance from the cages, gradually moving upstream to avoid potential cross-contamination during sampling.

Fig.1 Picture of a keepnet as used in the field experiment (a). A map shows the two river transects (b, c) with on the left the contrasting river discharge rates. The illustration (right) shows the concept of eDNA emission and downstream transport from the source, i.e. fish,



and simultaneously displays the location of the field experiment.

The experiment was repeated in two river transects with contrasting river discharge rates. Within the upstream, low discharge river transect, the experiment was performed under two varying fish biomasses. Given this experimental set-up, effects of variable biomass can be tested in the upstream transect, whereas potential effects of differences in discharge can be tested for the high biomass scenario carried out in both river transects.

All samples were analysed via both droplet digital PCR (ddPCR) of four preselected species, as well as via eDNA metabarcoding for all species in both the cages and the natural, background fish community.

Results and Discussion

We reveal the impact of both source biomass as well as system-specific river discharge rate on the spatial reach of these eDNA molecules. A plume-shaped downstream transport of the eDNA molecules is confirmed in both methods, with a strongly decreased detection rate beyond the 2 km sampling point downstream from the source population. This is due to an effect of homogenization and dilution strengthened with increased river discharge rate. In addition, interspecific variation in eDNA persistence causes an increase in stochasticity within the community-wide screening of this river with increasing distance from the source.

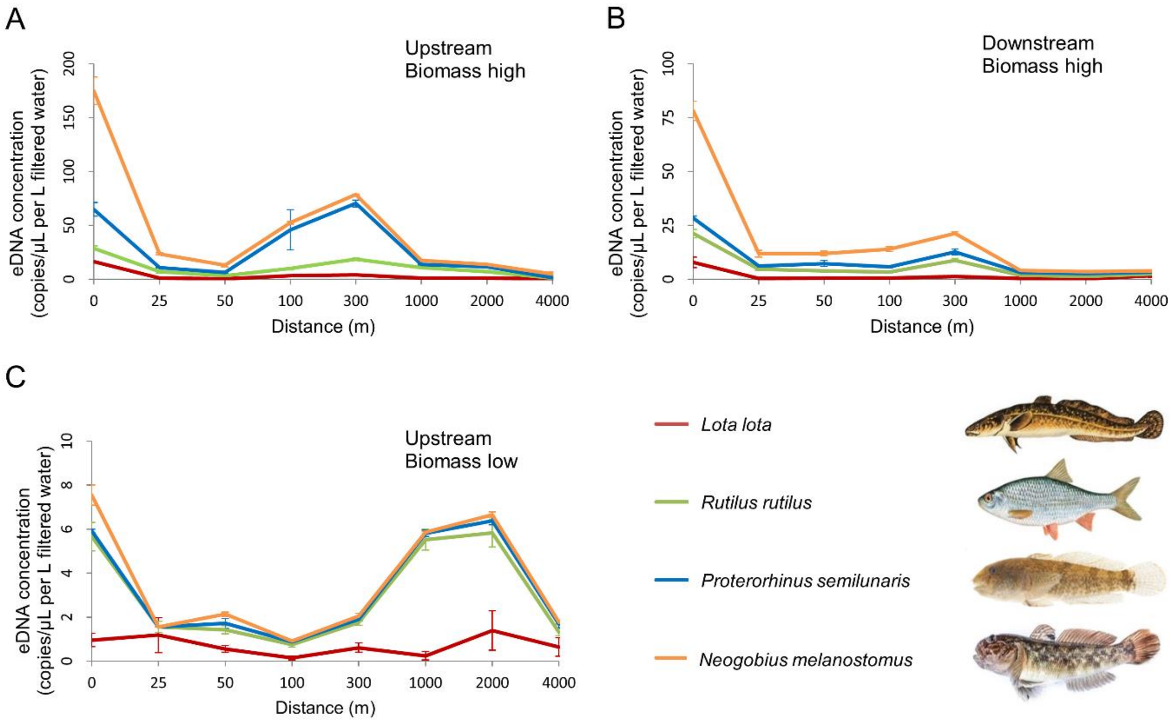


Fig.2 Mean eDNA concentration in absolute number of copies per µL DNA extract, standardized per L water filtered, at increasing distance downstream from the cages in two different stream transects, with a high (b) and low (c) initial biomass in the upstream transect.

Besides concrete application of species-specific methods for presence-absence investigation of both native and invasive species in contrasting occurrences, we found positive linkage between relative biomass of the eDNA source and its representation within the metabarcoding data. Obtained community compositions remain stable between 25 and 300 m from the source. The detection of elusive species via eDNA metabarcoding, remains remarkably high even at large distances.

Future

We strive for a continued development towards implementation of this eDNA-based biomonitoring in lotic environments and work on critical aspects of sampling and quantification of eDNA, allowing the use of these methods as a tool to assess ecosystem health in a variety of aquatic environments.

Acknowledgements

This work was co-funded by the Research Foundation - Flanders (FWO) (1S23822N and K108823N).

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Abstracts of poster presentations that did not provide Extended Abstracts

Monitoring the Commercial Fisheries of the North Pacific

Gwynne Schnaittacher and Jennifer Cahalan

Pacific States Marine Fisheries Commission, United States

Designing and implementing monitoring programs is a challenging task that is critical to sustainable management of fisheries. Monitoring data are an important component of a wide range of fisheries related activities, including quota management, stock assessments, assessment of protected species fisheries interactions, and fisheries science research. The fisheries that are monitored are also diverse, consisting of a variety of vessel types and sizes, ranging from large factory vessels that process catch at sea to smaller vessels that deliver catches to shoreside processors. Sitting at the intersection between this diversity of data needs and range of sampling situations, monitoring programs have to balance data collection needs and observer workloads while maintaining the scientific credibility of the monitoring design and minimizing impacts to vessel operations.

The Fisheries Monitoring and Analysis Division (FMA) of the NOAA Fisheries Alaska Fisheries Science Center is responsible for monitoring the federally managed groundfish fisheries in Alaska. Monitoring strategies used by FMA have been developed in tandem with the fishing industry, and as a result, these strategies are tailored to both industry and data users needs. The monitoring design includes deployment of observers, both at-sea and at shoreside processing plants, as well as electronic technologies into the fisheries. The Program utilizes a hierarchical randomized sample design, collecting data at the trip, fishing event, and individual fish levels. We will present a summary of the amounts and types of monitoring data collected, for both observer and electronic coverage, over the range of fishing operations alongside a description of how these collections meet the data needs of our constituents. In spite of the sampling challenges inherent in sampling commercial fisheries, the data collected provide extensive, high quality data that is utilized throughout the fisheries community.

Session 9. Harmonizing and standardizing monitoring programmes

Leader: Jørgen Dalskov

The harmonization and standardization of at-sea monitoring programs are key for maximizing data quality, particularly if the data from these programmes are shared and pooled between countries, regions and stocks. Examples of this are the disparate at-sea monitoring programmes in the U.S. and EU and their common data uses. Co-ordinated approaches reflect the diverse needs of regional/national observer programs while achieving consistency in key areas of importance, such as funding, safety, health and data quality. This session reviewed and identified the best practices adopted in national and regional programs and explored various approaches for coordinating observer programs.

Oral Presentations - Extended Abstracts

International collaboration to standardise high seas monitoring

Tiffany Vidal, Craig Loveridge, Randy Jenkins

South Pacific Regional Fisheries Management Organisation, New Zealand

Introduction

The South Pacific Regional Fisheries Management Organisation (SPRFMO) was established in 2012 to manage the non-highly migratory fisheries resources of the South Pacific Ocean. SPRFMO is currently comprised of 17 Members and 2 Cooperating Non-Contracting Parties (CNCPs), representing membership from Asia, Oceania, North and South America, the European Union, and Africa. One of the critical challenges that the SPRFMO, and other similar RFMOs, face is the collection of standardised high-quality data on fishing activities to effectively monitor, assess, and manage these fishery resources. Although the SPRFMO Convention called for the establishment of an observer programme to monitor fishing activities and collect data for scientific and compliance purposes, there were challenges to the implementation given the diversity in targeted fisheries as well as the Organisation's membership.

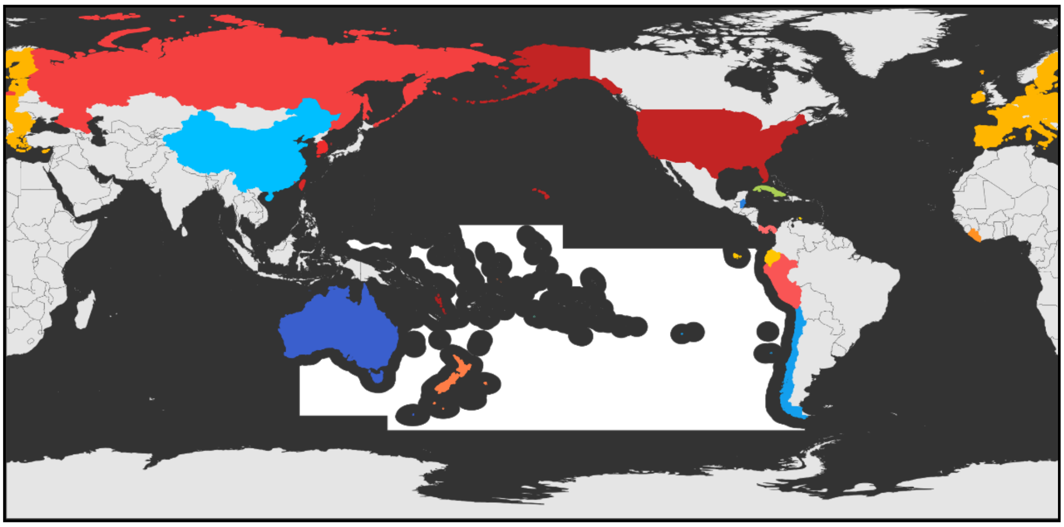

Figure 1. Illustrative map highlighting the parties of the SPRFMO Convention. The white region in the centre of the map represents the SPRFMO Convention Area.

<u>Fisheries of SPRFMO</u>

There are three main fisheries in the SPRFMO Convention Area: bottom fishing for orange roughy and other deepwater water species, mid-water trawling for jack mackerel, and squid jigging for jumbo flying squid. In addition, there are several exploratory fisheries targeting toothfish with longline gear and lobster and crab with potting gears. Each of the different fisheries has a mandated minimum observer coverage level, ranging from 100% in the bottom fisheries to 5% (or 5 full-time observers) in the squid fishery. Exploratory fisheries require 100% observer coverage in line with the precautionary approach.

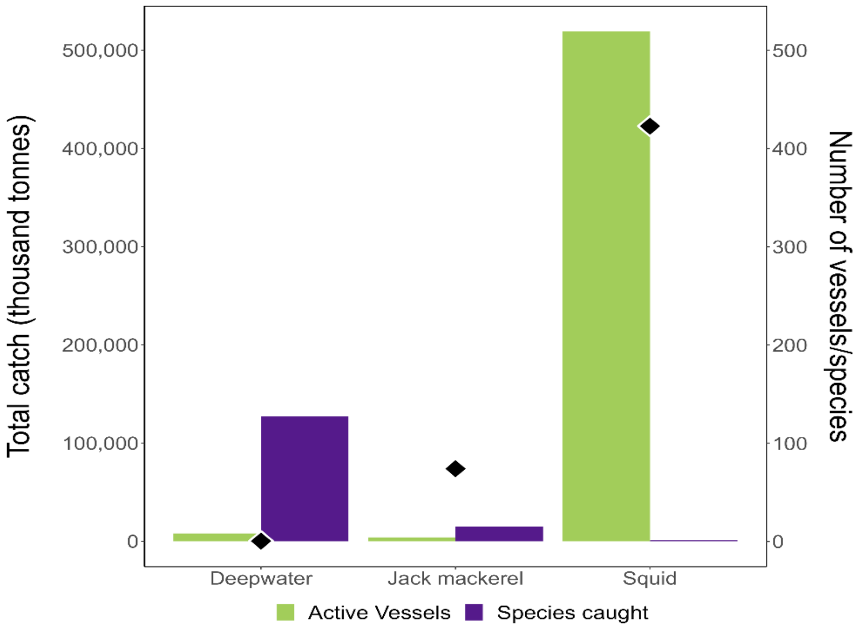

Figure 2. Summary statistics of catch volume (black diamonds, primary y-axis), number of active vessels and species encountered (secondary y-axis) for the three main SPRFMO fisheries in 2021.

At-sea transhipments are an important part of some of the fishing operations in SPRFMO, given the vast area across which fishing activities may occur. The frequency of transhipment events has increased rapidly over the past few years with the expansion of the jumbo flying squid fishery. In 2021, over 400,000 tonnes of jumbo flying squid were transhipped in the Convention Area.

Background to the Observer Programme

At the 6th annual meeting of the SPRFMO Commission (2018), following 2 years of intersessional working group activities, a Conservation and Management Measure (CMM) for the SPRFMO Observer Programme was adopted (CMM 16-2018). This measure, agreed upon by Members, set out the framework for a regional observer programme, complete with minimum requirements for accreditation. The CMM maintained the flexibility and autonomy for Members to utilise observers sourced from national observer programmes and service providers, so long as those programmes are fully accredited by the Commission, as of 1 January 2025. Up until that deadline, Members are permitted to deploy observers from non-accredited national observer programmes.

The Commission established the criteria by which programmes would be evaluated and selected an independent accreditation evaluator to assess Member observer programmes and interested service providers. The evaluation criteria are comprehensive and range from impartiality and integrity to safety standards, training and debriefing requirements, data quality and validation processes, to insurance and liability. Once approved, a programme is accredited for five years.

Since 2018, the programmes of 6 Members and one service provider have been accredited, 2 Members are currently in the process of accreditation, and 2 additional Members have expressed interest in pursuing accreditation in the coming year with the specific aim of deploying observers on carrier vessels to monitor transhipment activities. Furthermore, one Member has an approved alternative observer programme for their artisanal fleet, given the unique challenges associated with observing small vessels.

Challenges and Opportunities

The development of an accredited regional fisheries observer programme is not without its challenges. Progressing conservation measures in RFMOs is often a slow process, as such decisions often reflect complexities that span ecological, socio-economic, and political realms. Decisions are often by consensus and may require extensive international collaboration, including bi-lateral and multi-lateral engagement and compromise. SPRFMO is a relatively young organisation, and the progress made thus far to advance a regionally accredited observer programme speaks to the commitment of Members to implement effective and appropriate monitoring of these high seas fisheries to ensure continued sustainable management and utilisation of the resources.

Although much attention has been focused on the initial accreditation process, accreditation of observer programmes is only one step towards an effective monitoring scheme. Considerations such as implementation of mandatory observer coverage rates, evaluation of data quality and accuracy, and mitigation of programmatic drift due to variability in national programmes, must be at the forefront of the conversations moving forward, especially with respect to accreditation renewal. In addition, continual improvements in the mechanisms for data collection, submission, debriefing/processing, and dissemination must be sought to ensure that the data collected continue to be appropriate and available for scientific and management purposes.

In an RFMO with such diverse membership, collaboration among Members is a valuable resource. For example, the European Union and United States (NOAA) have supported the establishment of the SPRFMO Observer Programme accreditation process, thereby reducing the financial burden on individual Members. Additionally, Members have many forums throughout the year to share their expertise and experience; such opportunities are helping to develop an observer programme that meets the needs of all Members while working towards reducing reporting burdens. For instance, electronic monitoring (EM) and reporting (ER) are gaining traction across the different fisheries. For some Members, EM and ER are already an integral part of their monitoring programmes, whereas for others, learning from the collective experience is expected to aide in the adoption of such technologies.

Conclusion

The development of an accredited fisheries observer programme is an important step towards effectively monitoring and managing the fishery resources in the SPRFMO Convention Area, in a standardized and harmonised manner. Developing a programme that meets the needs of all Members and fisheries and is effective in collecting the necessary data to support science and management will remain a significant and evolving challenge. Collectively, within the SPRFMO and among similar RFMOs and national programmes, the benefits of enhanced collaboration, information sharing, and general willingness to engage in open communication to find appropriate solutions to these challenges will remain invaluable.

Acknowledgements

We sincerely thank the European Union and NOAA for their generous contributions to support the establishment and development of a fully accredited SPRFMO Observer Programme.

SPRFMO South Pacific Regional Fisheries Management Organisation

Co-funded by the European Union

Inclusivity of Fisheries Observers in American Samoa

Stephen Kostelnick

National Oceanic and Atmospheric Administration, American Samoa

American Samoa's "Heart of Polynesia" location and unique political status creates an especially diverse web of Fisheries Observers deployed in and out of the port of Pago Pago.

Location:

In relation to fisheries management, American Samoa is located in the Western Pacific within close proximity to some of the most productive tuna fishing waters in the world. The Eastern Pacific Ocean (EPO), also prime for tuna fishing, is about 1,400 miles east. While both US longline and US Purse Seine vessels offload to the local Starkist cannery, other vessels also offload or transship in American Samoa. Aboard the numerous vessels that fish in the tuna rich waters in the Pacific the NOAA American Samoa Field office provides personalized support to various fishery observers.

Political Status:

American Samoa is the southernmost territory of the United States of America. American Samoa's unique political status of being a U.S. territory surrounded by numerous independent island nations creates special logistical challenges for observer providers in Pago Pago.

Observer Providers by fleet:

U.S. Longline – Pacific Islands Regional Office (PIRO) American Samoa Observer Program – U.S. Citizens
U.S. & Non U.S. Purse Seine – Fisheries Forum Agency (FFA) member countries - Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu. **(note that American Samoa is not a FFA member)*
Purse Seine vessels fishing in the (EPO) - Inter-American Tropical Tuna Commission (IATTC) – Mexican & South American Observers
IATTC Tuna Transhipment Observer Program – MRAGAmericas - U.S. Citizens

This oral presentation explored the special challenges the NOAA PIRO American Samoa Observer Program Remote Field Office addresses in order to provide inclusive observer support to various observer programs while celebrating the diversity of its observer pool.

Review of Methodologies for Detecting an Observer Effect in Commercial Fisheries Data

Debra Duarte

National Marine Fisheries Service, Northeast Fisheries Science Center; University of Massachusetts Dartmouth, School for Marine Science and Technology

The observer effect occurs when the presence of an observer causes the fishermen to behave differently than they would on an unobserved trip. Examples include fishing in an area of lower bycatch, using a different type or size of gear, or reducing trip duration. Deployment effects occur when trips or vessels are not sampled in a representative manner, for example by prioritizing friendlier vessels, shorter trips, or more accessible ports. Non-representative sampling may lead to biased estimates, causing errors in total catch estimates, inaccurate stock assessments, and non-optimal target reference points (Rudd & Branch, 2017; Babcock et al., 2003).

Simulated data were created, conditioned on groundfish landings in the New England large mesh otter trawl fleet, and a range of artificial observer and deployment effects were introduced. Several published methods for detecting observer effects were tested. First, differences in observed and unobserved within each simulation were tested with a two-sided Welch's t-test for difference of means (no assumption of equal variances) and an F-test for difference of variances (ANOVA F-statistic) (following Rago et al., 2005 and Liggins et al., 1997). Second, a generalized linear mixed effect models (GLMM) was fit to the data, using vessel as a random effect and "observed" as a nominal binary variable (following Faunce & Barbeaux, 2011). If removal of the observed term resulted in a higher AIC value, it was considered strong evidence that an observer effect had occurred.

Thirdly, pairs of sequential trips were compared for differences between observed-unobserved pairs and unobserved-unobserved pairs (following Benoît & Allard, 2009). This involved creating sequences of either three sequential unobserved trips (U-U-U) or an observed trip between two unobserved trips (U-O-U). From each sequence, the middle trip was compared with either the first or the last trip (chosen randomly) to create a pair of unobserved trips (U-U) or an observed trip paired with an unobserved trip (O-U). The difference in landings for each pair was standardized by the average landings on unobserved trips for that vessel. In the absence of an observer effect, the distribution of O-U differences should be similar to the distribution of U-U differences. This was tested using a two-tailed Kolmogorov-Smirnov statistic. The median difference was calculated as the median of U-U values minus the median of O-U values. If the bootstrap 95% confidence interval did not include zero, the conclusion was that observer effect was present.

Results showed that the existing methods for detecting an observer effect can be reliable under certain conditions, which vary by the test. An ideal test would have a low false positive rate (α), have a high true positive rate (power), provide a precise and unbiased estimate of the effect size, and be reliable across various underlying distributions. No single test reviewed here fit all these criteria.

Both the t-test and F-test were unable to distinguish deployment and observer effects. These methods could be used for answering overall questions such as "are observed trips representative of unobserved trips" but should not be used to evaluate observer effects specifically (as opposed to any other type of systematic bias).

The GLMM test performed most consistently over the range of simulations presented here, particularly in the moderate coverage range of 25-75%. However, it was not able to detect smaller effect sizes, particularly at low coverage. Estimated effect sizes tended to be accurate but also suffered from wide margins of error, though not as large as the t-test estimate. This method possibly suffered because it could not be optimized for any single dataset, and other covariates (e.g., vessel size, season) did not exist in the simulated data.

The Kolmogorov-Smirnov and median difference tests had high reliability at moderate coverage (10-40%) without deployment effects, but performance decreased as coverage increased. At high coverage (>60%) these methods should be avoided because of the high rate of false positives and false negatives. Even in the ideal range, the median difference tended to underestimate the magnitude of the observer effect, with a misleadingly narrow confidence interval that did not always contain the true value. However, these methods were able to detect smaller effect sizes than the other methods and distinguish between observer and deployment effects. The major caveat with the triplet selection method is that it does not use the entire dataset. As coverage rates rise, the likelihood of back-to-back observed trips increases, reducing the number of “U-O-U” sequences, until the only vessels remaining in the analysis are those with the fewest observed trips. In addition, because of the random selection of the first or last trip in a triplet, re-running the analysis could lead to different results.

It would be inaccurate to label any difference arising from random processes as a deliberate shift in behavior. Likewise, it is incorrect to assume that mitigation measures intended to reduce observer effects would also reduce other uncertainties (such as deployment effects, observer error, etc.). When observer data are suspected of not being representative of total fishing effort, the underlying reason should be evaluated before potential mitigation actions are taken. It is also important to consider how those actions will impact the ability to determine whether the issue has been resolved. For example, increasing coverage rates too high would invalidate the use of the triplet selection method.

Unfortunately, the tests investigated here did not always provide simple, accurate results. They were often contradictory with each other for the same dataset, sensitive to changes in coverage or other parameters, confounded by deployment effects, or imprecise in their estimates of effect sizes. Using all five tests in combination may require interpretation of conflicting results, but likely provides the most complete understanding of the fishery under investigation.

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The Utility and Benefit of Standardized Vessel Monitoring Plans in Electronic Monitoring Programs

Nichole A. Rossi

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Introduction

In the northeast U.S., vessels must have an approved vessel monitoring plan (VMP) to participate in electronic monitoring (EM) programs. The VMP is multifaceted. In terms of management, the VMP provides clear objectives and outlines EM program requirements for a specific vessel. At the technical level, it describes how an EM system is configured on a particular vessel and how fishing operations must be conducted to effectively monitor catch. From the logistical perspective, the VMP is the communication tool that identifies roles and responsibilities among parties (e.g., fisher, EM vendor, regulatory organization) and facilitates program coordination to meet monitoring goals. Because the VMP is the regulatory tool at the centre of any EM program, its structure and content are critical to monitoring goals and program success. As such, standardizing the information in the VMP creates a cohesive strategy for developing VMPs. In addition, standardization provides the regulatory organization the ability to ensure all VMPs meet monitoring objectives in a consistent method and allows for a streamlined process for VMP approval.

Along with VMP standardization for program consistency and effective governance, a structured process for managing VMPs is beneficial. Structuring functions central to EM operations, such as; VMP approval, status of EM vessels (active/not active), documenting equipment malfunctions and VMP compliance issues through a management tool provides functional support for program managers. In addition, a management tool could serve as the primary source for shared access, file storage, and archiving.

Methodology

Critical elements to a VMP may include, for example the following categories: Contact Information, Trip Notification Requirements, Vessel Owner/Operator Responsibilities, System Specifications and Installation (See Figures 1 and 2 Vessel Diagrams), Catch Handling Requirements, Troubleshooting, and Signature Page. While standardization creates cohesion, it also allows for vessel specific operations and variation as it relates to specific fisheries, catch handling, and vessel layout.

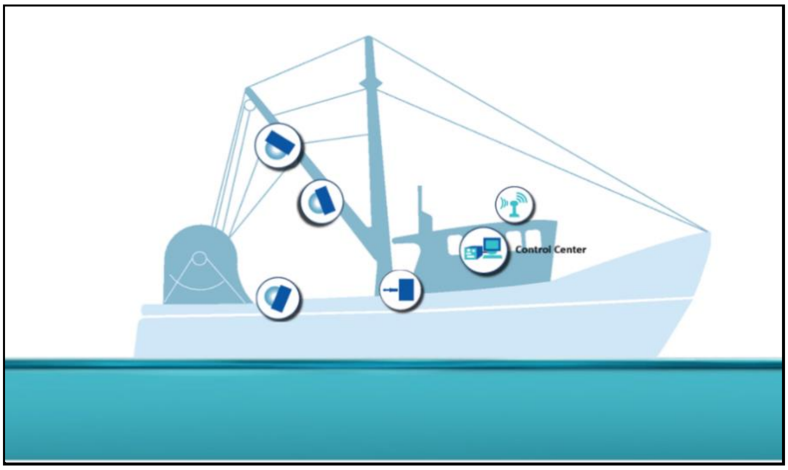

Figure 1. Vessel diagram example of system component placement

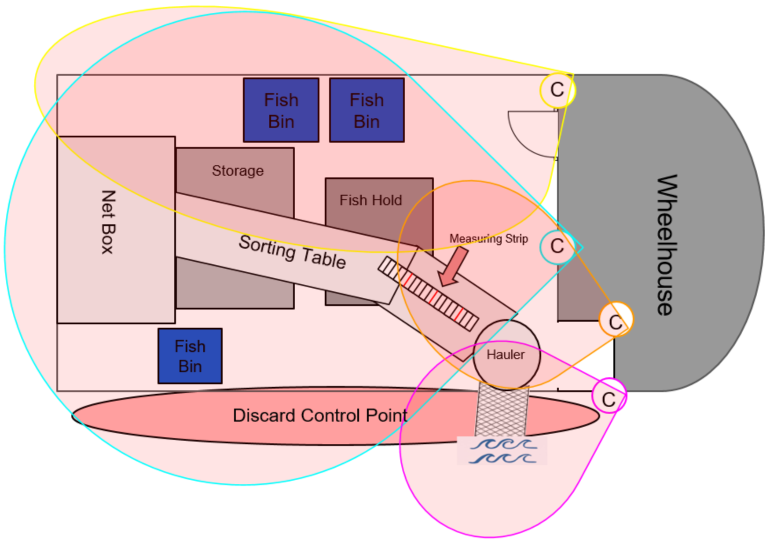

Figure 2. Vessel diagram example of work deck during fishing activities

To facilitate standardization, a VMP template or guidance document could be used to create the desired format. The template or guidance would outline the VMP structure, requirements, and essential components necessary for approval. In addition, any required items that directly relate to compliance or regulations may be included in the guidance to reinforce requirements and support enforcement actions. Potential examples could include: fishing notification and portside sampling requirements, provisions for notifying the authorities of equipment failures, and camera operational and maintenance obligations. VMP guidance may also serve as a source to outline ancillary information related to VMPs or the EM program structure.

<u>VMP Management</u>

In the northeast U.S., the Vessel Monitoring Plan Document Management (VMAN) application was developed for the purpose of structuring operations central to VMP approval and management of EM programs. The VMAN application offers logistical functionality for monitoring VMP submissions, active or approved VMPs (status), and documentation of vessel specific equipment malfunctions and VMP compliance issues. VMAN allows users to track, view, comment, and respond to inquiries on active VMPs. In addition, the application is used to document, log, monitor, and resolve vessel-specific issues (equipment, crew-related, procedural, etc.) that may impede data collection.

The VMAN application is a multiple-user system, that facilitates transparent communication among the regulating authority, fisher/owner, and EM service provider. All communication is stored internally on the VMAN application and is archived to support management or enforcement initiatives (if needed). This eliminates nebulous communication that may occur among informal conversations or email exchanges and provides a clear communication channel.

Results and Discussion

There are many facets to EM programs and specifically EM management that would significantly benefit from structure processes such as those listed above. As the regulatory tool at the center of any EM program, the framework of VMPs are critical to monitoring goals and program success and therefore standardization of regional VMPs is encouraged to support effective management. Through standardization, information such as VMP submission and approval timelines, approval process, authorized sampling strategies, and standard cameras views by gear type (See Table 1) would be a part of the EM framework. That information would also be working standards among approved service providers and participating vessels.

Bottom Otter Trawl Camera Requirements	
CAM 1	Primary view of discard processing station; used to collect length measurements and assess subsampling procedures, view of designated location for stowing groundfish discards.
CAM 2	Primary view used to monitor catch sorting operations, includes location for retaining groundfish discards; secondary view of length measurement station.
CAM 3	Primary view of stern and gear; may include work deck and discard control points.
CAM 4	View of work deck/stern discard control points at rails.

Table 1. Camera requirements for bottom otter trawl. The following information outlines the camera requirements for each electronic monitoring program and gear category. This section is not prescribing the order or number of required cameras, but rather the required views.

The VMAN application offers a reference point for VMP status and communication, and provides a contoured process to manage various facets of VMPs to support EM programs. Incorporating best practices learned and incorporated as part of successful operational EM programs around the world are key strategies for program success and the implementation of effective monitoring programs.

Given the importance of VMPs in EM programs, particularly as the primary communication tool that identifies roles and responsibilities among parties and facilitates program coordination to meet monitoring goals; effective standardization and management of VMPs is essential to program success. The utility of standardizing the structure of VMPs provides firm guidance on program expectations and results in a universal template for service providers and participating vessels. Like any monitoring program, EM programs require effective governance and the benefit of a working VMP template, is it allows a streamlined approach to management.

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FAO Deep-sea Fisheries under the Ecosystem Approach (DSF) project

Keith Reid[1, 2] and Anthony Thompson[1]

FAO DSF Project Consultant[1], Ross Analytics[2]

The International Guidelines for the Management of Deep-sea Fisheries in the High Seas was adopted by FAO in 2008 and recognises the importance of observers and the implementation of national and international cooperative observer programmes in collecting information and supporting both compliance with regulations and data for stock assessments and significance of impacts (paragraphs 36, 54, 55). In reality, and even though RFMOs tend to classify observer duties as being for compliance or science, they actually have a mix of responsibilities. Most RFMOs have requirements for observers in deep sea bottom fisheries and have observer programs established primarily to record retained catch and collect scientific data, such as length-frequencies, biological samples, and fish tagging. The fine-details of the duties and responsibilities of observers and the level of observer data reporting differ among RFMOs. However, it is clear that observers are being requested to collect both more information, and more diverse information. Observers are typically provided by RFMO Contracting Parties (CP), usually through a provider, and their duties are often a mix of RFMO and national requirements. Furthermore, the information the observers collect belongs to the CP providing the observer, and this is passed on to RFMOs in varying resolutions: individual fishing event level data, or at summary information at lower (daily) or much lower (trip) spatial and temporal resolutions. Much is also brought to meetings in a summarised form by representatives of CPs.

The Food and Agriculture Organization of the United Nations (FAO) has long been supporting observer data collection, and has provided and offered training for the use of an extensive accumulation of fish identification guides (e.g. Fischer, 2013). It is appreciated that the recording of catch retained on the vessel is reasonably well recorded, and that this can be “checked” through at-sea and in-port inspections. Discrepancies can become a compliance issue with a formal procedure to impose penalties if not undertaken correctly. This is certainly a deterrent to the incorrect recording of retained catches and, on the rare occasion this occurs, it is discussed at length in RFMO Compliance and Commission meetings.

The same cannot be said for the recording of discarded species, even when this is required by RFMO measures. This is not subject to additional checks and is rarely, if ever, raised as a compliance issue. However, such information is vital in ensuring that fisheries are not significantly impacting on populations of both commercial species and vulnerable species, like deepwater sharks and/or corals and sponges from vulnerable marine ecosystems (VMEs).

It is often reported by RFMOs, and the scientific committees in particular, that there is a shortage of information on catch (retained and discarded) for analyses. There are many potential reasons for this, including the tremendous workload placed upon observers who invariably have to work alone under difficult and sometimes dangerous conditions. The purpose of this paper is to plan future work with observers and their CPs to identify the challenges and priorities they face and to provide solutions in this regard. These could be:

- Understanding the time taken to undertake each task,
- Prioritising tasks and establishing the amount of information collected,
- Ensuring that collected information is used by CPs and RFMOs,
- Providing observers with new tools to make their tasks more efficient, and
- Promoting the use of new technologies, such as camera systems and image analysis, that promote safety-at-sea and allow observers to undertake more "human" tasks like otolith sampling.

FAO has begun implementing the Global Environment Facility funded *Deep-sea Fisheries under the Ecosystem Approach* (DSF) project (2022 to 2027)[i]. A major focus is on observer programmes to improve sustainable management practices for DSF, including data to assess data-limited stocks and to prevent impacts on deepwater sharks and VMEs. An important aspect of this work will include reviewing the duties and responsibilities of observers, the level of observer coverage required and the use of observer data by RFMOs in the management of deep-sea fish stocks, non-target species and vulnerable marine ecosystems. The project will also support the use of camera and video systems combined with image analysis software to support on-board data collection. More specifically, is the project will work on:

- International obligations to manage fish stocks and reduce fisheries impacts on biodiversity,
- Improving the science-management interface and industry contributions to fisheries management,
- Developing a platform to share information on new technologies that support observer duties,
- Supporting observers to collect data on retained and discarded catch for improved assessments (undertaken with ICES), and
- Support observers to collect information on deepwater shark catches.

The initial activity, and the reason for presenting to this the 10th International Fisheries Observer and Monitoring Conference, is to develop a network of observers that the DSF Project can collaborate with, with hope that the collaboration can bring mutual benefits to both parties.

<u>Reference</u>

Fischer, J. ed, 2013. *Fish identification tools for biodiversity and fisheries assessments: review and guidance for decision-makers. FAO* Fisheries and Aquaculture Technical Paper No. 585. Rome, FAO. 107 pp

Open Discussion Session

James Grunden to Debra Duarte
Q: Were you able to take into account any differences in market pressure for the different fisheries and vessels you are doing the observer effect analysis in and how their ability to make less or more money might sway them to be able to take trips off or fish less productive areas when they had an observer versus when they didn't have an observer?
A. Market factors were not taken into account as she was doing simulations only. However, it is something she is very interested in doing as she expands it out to include different fishing activity in the future.

Mario Lopes Dos Santos to Debra Duarte
Q: When you talk about observer effect, what sort of other sources of reference data did you use? For example, inspection date, catch analysis etc.
A. This was simulated data so other sources were not included.

Joo Youn Lee to Nichole Rossi
Q: Does the VMAN application have any data analysis function, and if not, are there other corporations or 3rd parties to analyse the data?
A. It has very limited data and it's really about how we manage the VMP's (Vessel Management Plans) and the issues that are documented and participation in a specific fishery. It's only internal information that we use at this stage as it's a fairly new tool so there hasn't been a lot of inquiries.

Steve Kennelly to Tiffany Vidal
Q: Is there much interaction between the big Pacific (PNA) program and yours (SPRFMO)?
A. No, not much sharing. Some overlap occurs - not with the PNA, but with WCP, SIOFA, CCAMLR. It would be beneficial to share, and not have each program create new things. Interesting to hear from Harold Vilia about the PNA, and their methods for training (whether to centralize or disperse). There is room to collaborate, and learn from each other to improve and increase consistency, especially in data-handling methods.

Joergen Dalskov to Nichole Rossi
Q: Do you run health checks on the systems daily? E.g. do captains have to check the system is working and the cameras are clean? If so, how do you do that?
A. Certainly a function test is required of any of the service providers and there is a component of the VMP that captains have to run the function test before they leave. If there was a problem, that would then document a system issue and enable them to be instructed on what to do with the issue. In terms of how often they update the VMP, they are approved for an entire fishing year. Everything is tested thoroughly before VMP approval.

Melanie Rickett to Nichole Rossi
Q: You have a lot of information on how and what content you want but what about the structure of the document? If there are multiple people looking at these, how are you getting consistency in the structure of the document itself? Is the vessel going into a portal and entering information or are you getting random documents?

A. These started as random documents, but now there is a general template with instructions so the Office of Law Enforcement, scientists, etc can all easily find information within the document.

Josh Lee to Stephen Kostelnik
Q: What advice would you give for port coordinators who have to place observers on vessels whose skippers aren't particularly excited about having an observer?
A. Go by the boat before deploying, have a conversation, get to know the skipper and bring the observer by as well. Find common ground, fishermen and observers aren't that different, they are all stakeholders. They need to have common courtesy and respect for each other. Observer has to show respect and show common courtesy too. Example story - I showed up to a vessel he was being deployed on, the port coordinator was there and didn't want him to go because he was writing out a citation for the vessel and there were bed bugs. There was a big quarrel and they asked him what he wanted and he said he just wanted to go fishing. So he went out, conducted himself professionally and got to know the crew and after 10 days the captain came out and said he was best observer he'd ever had because he didn't even know he was on the boat.

Steven Todd to Stephen Kostelnik
Comment/observation for Stephen – you lead with empathy and ability to find common thread with the people that you work with. That has been key for my own success as an observer, particularly on foreign vessels with limited English. Does attitude affect attrition rate?
A. We still struggle to find observers for American Samoa. Trips are long with observer s being placed on up to 160 day trips. Vessels might be delayed for covid or for repairs, which can leave an observer stranded in a strange port with no work.There needs to be more recruitment of locals to the observer program.

Colleen Rodenbush to Nichole Rossi
Q: I've never had access to a VMP, where do I get them?
A. That is up to your program coordinator, and you should have access to them so go see them.

Rachel Mahler to Debra Duarte
Q: Do you randomly select vessels to check for an observer effect or is it observer reported?
A. The project was looking at 3 methods to potentially test for observer effect. Fishermen freely admit to observer effect (fishermen fishing differently with methods, gear, and locations while an observer is on board)
Q: Can this be reported to enforcement or is there any regulation against this?
A. No regulations to say that fishing has to be done in a certain way but if it's a fishery they have to declare that they have to use a certain gear type or fish in a certain area then they do have to comply with those regulations. So no, nothing to say they have to change their behaviour.
Q: Could fish effort numbers change due to observer effect?
A. To rephrase the question, if you know there is an observer effect in a fishery, do we make adjustments to the discard data or other estimates to reflect this? Currently not, but

this is something of interest and I want to look at ways to avoid observer effect to begin with or mitigate it once we know that it's happening.

Eldene O'Shea to Tiffany Vidal
Q: When working with international RFMOs, different stakeholders (e.g SPRFMO and CCAMLR) can have different objectives, can it be standardized at all for the things they do have in common?
A – I've only been at the SPRFMO program 1.5 years and it's continuously evolving so no answer yet. Perhaps just working with other programmes and learning about them? It's not like we are in competition with each other. Very different fisheries and programmes are involved, so we look at what's working well and develop best practice around that and working together.
Comment from the Pacific perspective – CCAMLR and WCPFC have an agreement to share data on trans-shipment vessels, which would presumably carry over into SPRFMO areas. Also some cross-organisational endorsements of observers occurs, so sharing is happening.
Comment from Keith Reid - from a global perspective, if we emphasise where there are similarities between objectives and what most organisations are trying to achieve, and focus on them instead of differences/difficulties it would be the best way to move forward. Too hard to standardise everything because everybody would have to agree on what one organisation is already doing.

Steve Kennelly to Debra Duarte
Q: Have you noticed any changes in levels of observer bias if there's a smaller number of boats in a fishery? E.g. three boats and only one gets an observer they all may work together to get around it?
A. Not particularly but they don't have fleets with just three boats, usually it's hundreds. Depending on changes in fleet dynamics there definitely could be a link or masking a link to the observer effect. If comparing last years' data and this years' data and fleet composition has changed, there might be a very different dynamic going on and it could look like you had an observer effect going on even if you didn't or vice versa. We haven't noticed this as yet but haven't looked at it either, so would be curious to try it out.

Craig Faunce to Keith Reid
Q: I also wrestle with how we incorporate the first-hand knowledge and observations of hundreds of observers on the deck of a boat, into scientific and management advice. They are eyes and ears on the water and the canary in the coalmine on what's going on in the ecosystem. What are your thoughts on this subject and what might be useful?
A. The scale of problem with that many observers is assimilating all that information, but it's increasingly becoming more important to do that. Our ability to process and analyze data is getting quicker but understanding the nuances of the data isn't accelerating at the same rate and it's a mistake to leave that behind. From my experiences interpreting CCAMLR data (rows and columns reporting as well as narrative log books), reading the narrative enriches your ability to unload the data. Even if it seems like an extra lot of work and is harder to format, it's definitely not wasted time. From an FAO perspective, they are very keen to get more of that narrative into the process because it's easier to present data with the context and understanding from the observer behind it.

Isaac Forster to Tiffany Vidal

Q: You mentioned that SPRFMO does tend to do things by consensus so was it be a consensus decision to have an accreditation standard for observers for SPRFMO??
A – I would have to go back to the report to find out as I'm not sure offhand. But there would have had to be a consensus decision to create the accreditation process.

Isaac Forster to Debra Duarte
Q: Have you looked at differences between observer effect? i.e between how each observer behaves.
A. Between trip variance can wash out any observer variance. In a previous role that was something I was very interested in; looking at observers who were misbehaving or poor performers and trying to identify them. It's very difficult with all the variety, even in just one fleet such as the trawl fleet. There was a lot of between trip variance that sometimes showed up as between observer variance. There were some ways to get around that and things to look for, and in some cases we did identify observers who were poor performers or who were deliberately falsifying data.

Isaac Forster to Keith Reid
Q: The feedback you are asking for in the observer experience project, is it specifically EM feedback?
A. It's very much about getting the wider observer experience. The questions relate to EM and is targeting EM but terminology varies between programmes so broad experience feedback is definitely welcome. As an observer, don't worry about the terminology, but what technology could be introduced that would make your job as an observer more efficient? And so, that efficiency would allow you focus on other parts of ecosystem impacts of that fishery. That's our main objective; what are the dumbest and most boring parts of being an observer and how can technology alleviate those? And maybe EM is the answer?

Abstracts of poster presentations that did not provide Extended Abstracts

Pecheker: a fisheries and ecosystem-based database for scientific monitoring and data curation in the Southern Ocean

Charlotte Chazeau

Muséum National d'Histoire Naturelle, France

The scientific monitoring of the Southern Ocean French fishing industry is based on the use of the Pecheker database. Pecheker is dedicated to the digital curation of the data collected on field by scientific observers and which analysis allows the scientists of the Muséum national d'Histoire naturelle institution to provide guidelines and advice for the regulation of the fishing activity, the protection of the fish stocks and the protection of the marine ecosystems. The template of Pecheker has been developed to make the database adapted to the ecosystem-based management concept. Considering the global context of biodiversity erosion, this modern approach of management aims to take account of the environmental background of the fisheries to ensure their sustainable development. Completeness and high quality of the raw data is a key element for an ecosystem-based management database such as Pecheker. Here, we present the development of this database as a case study of fisheries data curation to be shared with the readers. Full code to deploy a database based on the Pecheker template is provided in a QR code in the poster. Considering the success factors we could identify, we propose a discussion about how the community could build a global fisheries information system based on a network of small databases including interoperability standards.

Martin A., Chazeau C., Gasco N., Duhamel G. & Pruvost P., 2021. Data curation, fisheries and ecosystem-based management: the case study of the Pecheker database, International Journal of Digital Curation, 16(1), 32 pp.

Session 10. New approaches to analysing monitoring data and use of bycatch data

Leader: Isaac Forster

As knowledge and technology increases, advances in new tools and strategies for analyzing fishery observer data and EM have been introduced to achieve sustainable fishery management. Moreover, other dynamics including, but not limited to, environmental, biological and socio-economic data have been integrated into observer and EM assessments. These advances have reduced bias and uncertainty and led to sustainable gains in bycatch (inclusive of protected species) reduction technology, more robust single and multi-species stock assessments, and holistic ecosystem and probabilistic modelling approaches.

In this session, we explored these new and innovative analytical approaches on how fishery observer data and EM are used in fishery management decisions.

Oral Presentations - Extended Abstracts

Electronic monitoring video expands opportunities for determining post-release condition of protected species following fisheries interactions

Jennifer Stahl[1,2], Joshua Tucker[1,2], Lesley Hawn[3], Amanda Bradford[1]

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[2] Cooperative Institute for Marine and Atmospheric Research
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Introduction

Protected species are incidentally captured in many different fisheries worldwide, but few of these interactions are documented when an observer is not aboard the vessel. With a growing number of protected species caught as bycatch at unsustainable levels, it is critical to quantify interactions and develop mitigation measures. Previous research conducted in the Pacific Islands indicates that protected species interactions can be detected in electronic monitoring (EM) video (Carnes et al., 2019; Stahl and Carnes, 2020). However, to improve population assessments, it is also necessary to predict the likelihood that an animal will survive after an interaction.

Currently, data needed by the National Marine Fisheries Service (NMFS) to monitor protected species interactions in the Hawaiʻi longline shallow- and deep-set fisheries are collected by human observers. However, the costs for observer coverage continue to rise, and the observer coverage is limited in the deep-set fishery. Presently, only 20% of deep-set trips are monitored by observers, while shallow-set trips have 100% observer coverage.

When protected species interactions occur during an observed Hawaiʻi longline trip, protected species experts use the data forms and video footage collected by the observers to determine the likelihood of post-interaction mortality based on standardized criteria such as condition of the animal at the vessel and at release, hook or entanglement location, and the amount of fishing gear remaining on the animal upon release. Specific criteria are defined for cetaceans in NMFS (2012) and sea turtles in Ryder et al. (2006). We conducted research to ascertain if EM provides the necessary data to determine mortality and serious injury for cetaceans and post-interaction mortality for sea turtles. This research is crucial to understand how EM can supplement the at-sea observer program in the Pacific Islands Region longline fisheries and to inform other developing EM programs for fisheries that incidentally interact with protected species.

Methodology

EM staff and protected species experts collected and reviewed videos for protected species interactions from deep- and shallow-set trips. EM systems were installed on volunteer Hawaiʻi longline vessels in two separate deployments: 18 systems in 2017 installed by Saltwater, Inc. and 20 systems in 2021 installed by IKE solutions. Each system consisted of a computer and two cameras as well as sensors for GPS, hydraulic, and magnetic rotation, with computer and sensor configuration according to Carnes et al. (2019). In both deployments, dome-shaped security cameras were used with 3 megapixels and a resolution of 720p in the first deployment and 4 megapixels and a resolution of 1080p in the second deployment. All EM systems were equipped with a “rail” and a “deck” camera; the “deck” camera captured activities on deck while the “rail” was used to capture imagery of fish and protected species in the water or alongside the vessel.

Videos of cetacean interactions were reviewed to determine if the data could be used to make determinations of mortality, non-serious injury, or serious injury based on criteria defined for small cetaceans (odontocetes except sperm whales) from Table 2 in NMFS (2012). NMFS defines serious injury as, “an injury that is more likely than not to result in mortality.” If data are insufficient to establish injury severity, then the injury “cannot be determined” (NMFS, 2012). The primary data needed to make a determination are species, location, and amount of attached fishing gear at capture and at release, and the condition and behavior of the animal at capture and release.

EM footage of sea turtle interactions was examined to determine if the data needed to assign a percent likelihood of post-interaction mortality could be collected. After video and data review, a percent likelihood of post-interaction mortality was selected from Table 1 in Ryder et al. (2006) based on the assigned injury and release condition and whether the sea turtle was a hardshell or leatherback, with leatherbacks assigned a higher percent (5-10% greater) likelihood of mortality for the same injury and release condition. An injury category was assigned (I-VI) based on the hooking or entanglement location and whether the sea turtle was comatose or resuscitated. The release condition was based on the amount of attached fishing gear at release.

Results and Discussion

A total of 8 cetacean and 37 sea turtle interactions were reviewed for this study. EM footage allows for determinations of mortality, serious, and non-serious injury for cetaceans and assignment of a percent likelihood of mortality for sea turtles. When camera views and imagery were optimized and fisher handling was visible, we were able to make determinations of mortality, serious, and non-serious injury for cetaceans and assign a percent likelihood of mortality for sea turtles. If the fishers are observed on camera cutting the animals from the line or coiling the remaining line, then it may be possible to deduce the amount of trailing line and the likely severity of injury that may result from the interaction. In addition, EM may offer enhanced ability to collect information compared to observer data, such as on cetacean behavior or fisher handling.

There were sufficient data to determine mortality, non-serious, or serious injury for 6 of the 8 cetacean interactions. For the 2017 camera deployments, some observations were hindered by limited field of view, dirty cameras, and orientation of the "rail" cameras; however, observations were improved after optimization in 2021. Although it is possible that more injury determinations will need to be assigned as "cannot be determined" for cetacean interactions from EM trips compared to those with an at-sea observer, EM footage may allow for determinations even on unobserved trips. Our study showed that even when cetaceans were not brought close to the vessel following protected species handling guidelines, it is possible that in some cases an injury determination could be made.

Our study demonstrated that the percent likelihood of mortality can be assigned with certainty for most sea turtles that are caught in the Hawaiʻi longline fisheries based on data collected from EM video. Generally, we could determine the injury and release condition of sea turtles as the majority were boarded and released with all fishing gear removed. However, for those released with trailing line or released from fishing gear while still in the water, there may be uncertainty in the injury or release condition resulting in a more conservative determination that potentially inflates the percent likelihood of mortality. With improved camera settings and resolution used in the second deployment, we were able to assign an injury category with certainty for 86% of the sea turtle interactions compared to 43% from the first deployment.

This research demonstrates that EM-collected data can provide an alternative data stream to improve estimates of protected species bycatch and quantify the impacts fisheries have on their populations. This is particularly important as many international pelagic longline fisheries have limited observer coverage yet interact unintentionally with protected species.

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Estimating the length of the terakihi fish using machine learning

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Introduction

Current practices for monitoring the catch of deep sea fishing vessels is labour intensive requiring a person on vessel measuring individual fish lengths manually. Capturing videos of fish on-vessel instead allows the use of machine learning algorithms for tackling a computer vision based problem to automate the collection of morphological data of the observed
fish.

In this research we investigate essential methods required and develop a system that uses machine learning algorithms and computer vision techniques to calculate centimetre accurate lengths of singulated fish from video footage.

Methodology

The first stage in this process is the data acquisition, where we explore the use of both a fixed camera and a free camera (one that is held in hand) for gathering the video data from which we extract millimeter lengths. Lengths were gathered on-site to compare the lengths found from images at different orientations and translations. An analysis of the different camera positions and rotations found that a camera positioned above the object of interest and calibration pattern was able to achieve the most accurate lengths. Rotation was found to have an increasingly detrimental effect on predicted lengths as rotation, measured in radians, increased.

Secondly, we use binary masks that are created both manually, and by using an automated approach, based on edge detection, for training a segmentation model to identify fish in images. We leverage shape features and interpretable ML classifier to analyse the features of contours from both inferred masks and those derived from an edge detection. In our analysis of these shape features, we identify a range of values for the feature “circle deviation” which may be used to identify potential fish contours that did not pass the classification, and flag such contours for further training. We use contours, derived from the edge detection approach, that do pass the classification for creating a dataset of cropped images, to train a GAN from which a synthetic imagery set is created.

Thirdly, we develop a method from extracting the lengths of fish from images by using a checkerboard pattern as a point of reference, to relate pixel lengths to millimeters. Only inferred contours with shape features within the range identified by our analysis are used in calculating lengths. This approach reduced the number of partially visible fish or false positive inferences from affecting our recorded lengths.

Finally, the performance of models trained on real images, synthetic images, and a combination of the two are compared. A model that was trained on both real and synthetic images achieved an average for the absolute differences between true and predicted lengths of below one centimetre over 128 samples. Our results suggest that the use of synthetic data to assist in the creation of a robust training dataset is viable. However, this synthetic data works best when there is also real data available in the training set.

Results and Discussion

Strict restrictions on reported lengths for undersized catch meant that a key objective of this research was to achieve centimetre accurate length predictions. We were able to achieve this goal on a holdout set of 128 images with an average absolute difference between predicted and measured lengths of 7.523 millimetres.

Concluding that models trained on both real and synthetic imagery will outperform those trained on just real imagery cannot be made from this research alone as there are too many external influences that may affect these results. The randomly chosen images for training each model, for example, may have been better suited for explaining the holdout set in the mixed model than those in the model trained on 700 real images. However, the results from this research are similar to those from other works exploring the use of synthetic imagery (Ros 2016). Suggesting that synthetic imagery for training deep convolutional neural networks performs best when used in conjunction with real images.

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Trends in fish by-catch reporting in the CCAMLR Krill fishery.

Stephane Thanassekos, Isaac Forster, Daphnis De Pooter, Steve Parker

CCAMLR Secretariat

Introduction

Understanding the magnitude, timing and location of fish by-catch in the Antarctic krill fishery is a priority for CCAMLR for the ecosystem-based approach to management. Vessels are required to report all target catch and by-catch, and independent scientific observers are tasked with sub-sampling krill catches and recording the number, weight and length distributions of each by-catch species.

A comparative analysis of vessel- and observer-reported data in 2014 showed a systematic difference in the frequency of occurrence of fish by-catch. As a result, CCAMLR implemented a strategy to improve by-catch data quality to better estimate by-catch rates (including an illustrated by-catch identification guide: https://www.ccamlr.org/document/science/common-fish-catch-species-ccamlr-krill-fisheries). The resulting trends are therefore more indicative of changes in reporting than changes in actual by-catch quantities.

Methods

The frequency of occurrence of fish by-catch was computed for each vessel and each fishing season (2010-2022) as a ratio between the number of haul records matching different conditions (presence/absence of fish, and presence/absence of SISO records).

By-catch rates (kg of fish per tonne of krill catch) were estimated by scaling observer-reported weights (from subsamples of the catch) to the total catch weight reported by the vessels, and their trends in space and time were analysed.

Results

The frequency of occurrence of fish in vessel records has generally increased over years and across vessels, suggesting that crew reporting is improving (Fig. 1). For some vessels, that frequency is converging with observer levels. Higher frequency of occurrence in observer samples is potentially due to the presence of low numbers of very small (juvenile or larval) fish in the catch, which the crew may miss.

Despite the presence of data quality issues, the preliminary analysis of by-catch rates indicates that the by-catch of fish in the krill fishery is characterized by the occurrence of sporadic and localized large by-catch events.

Conclusion

Understanding the characteristics of the data and its quality will provide support for improving data collection forms, instructions, and training for both observers and vessel crew. Now that all vessels have SISO observers on board, a review of workload, sampling objectives, sampling requirements, and associated data quality issues could be undertaken to ensure high quality data for future analyses. Many of the taxa found as fish by-catch are not well studied and improved data collection protocols would provide research opportunities to better understand their life-history, particularly in the early life stages.

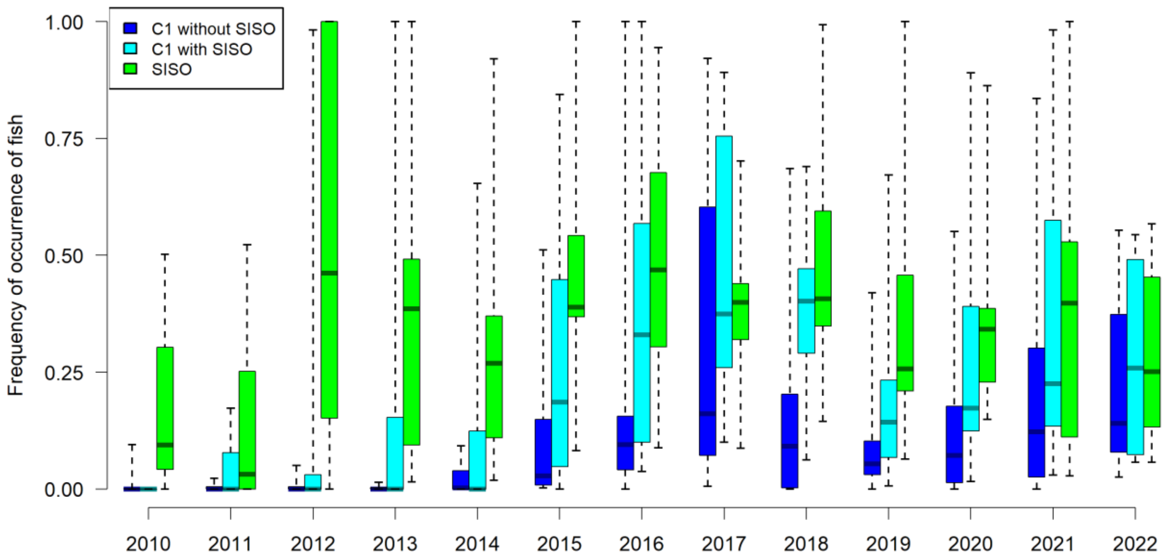

Figure 1. Frequency of occurrence of fish in by-catch records of the krill fishery in each season. The colours correspond to the three ways frequencies are computed (see Methods in WG-FSA-2022/03). *N.B.* 2022 data is incomplete.

Quantifying bias in fisheries monitoring programs: permutation tests, simulated sampling, and the effect of data transformation

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Introduction

Fishery monitoring programs in which fewer than 100% of fishing events are monitored (i.e., partial coverage programs) must be regularly evaluated, because sampling makes inference from the resulting data susceptible to higher levels of imprecision and potential bias compared to programs with complete coverage (i.e., full coverage programs). One indicator of potential bias that has been documented in some partial coverage fisheries is when catch characteristics and fishing effort differ between observed and unobserved trips (Benoît and Allard, 2009). These differences are known as *observer effects*. Here we use the general term *monitoring effects* to refer to differences between trips that are monitored (with either observers or electronics) and those that are not monitored.

Monitoring effects are of concern to fisheries managers who rely on monitoring data to estimate discards and ensure that catch limits are not exceeded, as well as stock assessment scientists who use biological and catch information collected by observers to model the dynamics of fish populations. If bias is shown to be present in these data, fishery scientists, managers, and industry are often interested in whether the bias changes their inference from the fishery data in a meaningful way, and in how to ameliorate the bias. The first question is relatively straightforward to assess in instances when monitoring bias can be measured directly by comparing monitoring data to another unbiased measure of catch (Liggins et al., 1997). However, as noted by Liggins et al. (1997), directly quantifying bias in estimates of discards is impossible because there is no unbiased measure of discards to compare observer estimates to. Therefore, monitoring effects on discard estimates must be evaluated indirectly, with metrics that are measurable for both sampled and unsampled trips.

The North Pacific Observer Program has both full and partial coverage components. In this study we draw on our experience from annual evaluations of the partial coverage component of the program to explore the issue of monitoring effects beyond simply detecting them. The first question we evaluate is: at what monitoring rates are monitoring effects reduced? The second question we evaluate is: how do the results from the first question change with the application of a data transformation recommended in recent research by Christensen and Zabriskie (2021)? Our results are broadly applicable and should be of interest to any partial coverage monitoring or sampling program prone to monitoring effects.

Methodology

In order to evaluate whether the act of monitoring resulted in biased data, we chose metrics that were measurable for both monitored and unmonitored trips and applied permutation tests to each metric. These metrics include: the number of National Marine

Fisheries Service (NMFS) areas fished, number of days fished, number of species landed, proportion of landed catch that is made up of the predominant species, total landed catch weight in tons, and vessel length overall (LOA) in feet.

Trip-level partial coverage data collected between 2017 and 2019 were used for this study. Data were collected by observers only in 2017 and by both observers and EM beginning in 2018. We performed analyses within trip groupings defined by gear type (hook-and-line, pot, pelagic trawl, and non-pelagic trawl) and monitoring method (observer or EM). This resulted in five groupings: EM hook-and-line (EM HAL), observed hook-and-line (HAL), observed pot (POT), observed non-pelagic trawl (NPT), and observed pelagic trawl (PTR).

We generated two versions of the source data - one untransformed and one in which a Box-Cox transformation (Box and Cox, 1964) was applied following Christensen and Zabriskie (2021). As in Christensen and Zabriskie (2021), the Box-Cox parameter λ was estimated within a range from -6 to 6 using maximum likelihood.

Permutation tests were performed for each combination of year, gear type, metric, and data transformation. Each permutation used 1,000 randomized label assignments to create a distribution of differences under the null hypothesis that monitored and unmonitored trips are the same (i.e. come from the same pool of trips). We calculated a *p*-value for the null hypothesis by determining what proportion of absolute differences from the 1,000 randomized label assignments were greater than or equal to the absolute difference originally calculated with the true label assignments.

We also investigate how monitoring effects – as measured by the permutation test – would have been reduced had additional monitoring been conducted on the original data set. In order to do so, we had to make assumptions about what characteristics the additional monitored trips would have, while noting that the true response of harvesters to increased monitoring is unknown. To provide a range of potential outcomes, we used two different methods to simulate increased monitoring.

We refer to the first method of simulated increased monitoring as 'uplabeling'. In uplabeling, we started with the original data set and then simulated additional monitoring by randomly selecting without replacement previously unmonitored trips and flipping their label to “monitored” before performing a permutation test. This method simulates additional monitored trips that have the same characteristics as trips that were originally unmonitored and can be thought of as an optimistic assumption of harvesters’ response to increased monitoring: that they would behave the same on each additional monitored trip as they behaved on the unmonitored trip.

We refer to the second method of simulated increased monitoring simply as 'resampling'. In resampling, we started with the original data set and then simulated additional monitoring by randomly sampling with replacement trips that were originally monitored. In order to keep the total number of trips constant, we then randomly selected (without replacement) an equal number of unmonitored trips to exclude. This method simulates additional monitored trips that have the same characteristics as trips that were originally monitored and can be thought of as a pessimistic assumption of harvesters' response to increased monitoring: that they would behave the same on each additional monitored trip as they behaved on the originally monitored trips.

We considered monitoring effects to be reduced once the median p-values (across 100 populations simulated at each step of the increased monitoring exercise) were above the Bonferroni-adjusted alpha level of $0.05 / 6 = 0.008\overline{33}$ among all six metrics. The Bonferroni adjustment controls for the fact that multiple tests (one for each metric) were being performed within each group, reducing the risk of rejecting the null hypothesis without sufficient evidence. In order to show the behavior of p-values and observed differences at monitoring rates beyond any cutoff based on p-value, we ran a separate simulation in which monitoring rates were increased to 100%. We performed all analyses in R (R Core Team, 2021). Although the data used in this study are confidential, the custom functions used to perform the permutation tests and uplabeling exercise as well as the code used to produce tables and graphics can be found at https://github.com/philganz/monitoring-effects-sampling.

Results and Discussion

The simulated monitoring rates needed to reduce monitoring effects based on p-value were lower when using the uplabeling method than when using the resampling method (Table 1). When data were left untransformed, sampling needed to increase from an original rate of 17.07% to an overall rate of 25.24% for the uplabeling method and up to 63.09% for the resampling method. When data were transformed, monitoring effects were reduced at an overall simulated monitoring rate of 27.18% for the uplabeling method and 62.59% for the resampling method.

Table 1. The number of total trips (N), monitored trips (n), and monitoring rate (r) of the original data. The results of the increased monitoring exercise are shown for untransformed and transformed data. The metrics that showed the most persistent monitoring effects are listed in column m as NMFS areas fished (A), days fished (D), number of species landed (S), predominant species proportion (P), landed catch weight (L), or vessel length (V). The minimum monitoring rates that were needed to reduce monitoring effects and the median percent differences (across simulated trip populations) at those rates are listed for the uplabeling method in columns r_u and d_u, and for the resampling method in columns r_r and d_r, respectively. Year and gear type combinations with no metric in column m represent cases in which the original data contained no monitoring effects with $p < 0.008$, and therefore were not included in increased monitoring simulations.

		Original		Increased monitoring results								
					Using untransformed data				Using transformed data			
Gear	Year	N	r	m	r_u	d_u	r_r	d_r	r_u	d_u	r_r	d_r
EM HAL	2018	775	24.26		24.26		24.26		24.26		24.26	
	2019	923	32.29	S	40.41	9.36	82.67	12.49	42.04	9.78	82.67	12.89
HAL	2017	2,836	9.70	D	24.01	-4.97	97.57	-12.71	25.99	-4.47	97.57	-11.06
	2018	2,005	15.41	D	37.11	-5.42	96.21	-12.65	38.60	-4.83	96.96	-12.16
	2019	1,766	17.38	D	30.12	-6.46	92.13	-11.75	43.71	-4.8	95.53	-11.92
NPT	2017	594	14.31		14.31		14.31		14.31		14.31	
	2018	587	18.40	L	35.43	-13.64	95.06	-27.07	36.29	-8.35	93.36	-13.72
	2019	571	23.47	S	34.50	-11.65	89.67	-17.16	30.82	-12.24	87.22	-16.26
POT	2017	1,216	5.92		5.92		5.92		5.92		5.92	
	2018	828	12.08		12.08		12.08		12.08		12.08	
	2019	596	13.42		13.42		13.42		13.42		13.42	
PTR	2017	1,604	21.57	D			84.10	-7.18				

		Original		Increased monitoring results							
				P	25.81	-0.15		25.81	29.39	75.62	36.2
	2018	1,378	20.68		20.68		20.68	20.68		20.68	
	2019	1,112	25.09		25.09		25.09	25.09		25.09	
Total		16,791	17.07		25.24		63.09	27.18		62.59	

In reality, we expect harvesters' response to increased monitoring to be somewhere in between the values for r_u and r_r reported in Table 1. That is to say, at some coverage rate between what was found under our optimistic (uplabeling) and pessimistic (resampling) assumptions, continuing to alter behavior on monitored trips would cost harvesters more than it benefits them, and they would begin to revert to their unmonitored behavior.

This study can be of value for other programs exploring the use of permutation tests to determine the likelihood that monitored fishing events derive from the same population as unmonitored fishing events. The opportunity also exists to investigate the effects of unrepresentative data on estimates of catch. Lessons and potential methods from this analysis may be adapted for that purpose.

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Innovative, spatially based and real-time, software solutions for fisheries management

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Introduction

Unintentional bycatch, in addition to be very harmful to the marine ecosystem, may also place significant financial implications when "chock" species, i.e., bycatch species, are overfished, resulting in premature termination of the fishing season for the permitted species. To avoid such premature closures, fishing managers, regulators, and scientists must have timely access to accurate fishing data, at a high-temporal and spatial resolution, of the targeted and bycatch species.

Achieving a significant catch reduction of unwanted or protected bycatch has proven to be a challenging task. This is especially the case when natural mixing of targeted and untargeted species is high. While there are several management and technical methods that can be deployed for bycatch mitigation, these methods often result in less effective and more costly fishing operations. For these reasons, fisher's best option is to be able to dynamically avoid high bycatch areas in real operational time. This can only be achieved by developing a real-time data collection and reporting system that can advise fishers in real-time which areas should be avoided to minimize bycatch take.

The Atlantic Ocean, off the northeast (NE) United States, is home to a valuable limited-access scallop fishery where Yellowtail flounder, *Limanda ferruginea*, is a frequent bycatch species. Yellowtail flounder, caught in the Georges Bank special access area scallop fishery, is governed by a sub-Annual Catch Limit (sub-ACL). Records indicate that often the yellowtail flounder sub-ACL has been reached before the full scallop allocation has been landed, resulting in a premature closure of the fishery. In other words, Yellowtail flounder act as a "choke" species to the main scallop fishery. To address this issue, the Northeast US scallop fleet decided to introduce a real-time electronic bycatch monitoring and reporting system to their system.

The main objective of this system is to have the fishers report their bycatch CPUE, mainly of the primary "choke" species (yellowtail flounder) and scallop catch, in real-time electronic format to a central database. This data is then anonymised and made available to the entire fleet to alert the fishers to avoid areas of high CPUE for bycatch species. This allows fishers to make informed decisions regarding where to fish to avoid or reduce the occurrence of yellowtail flounder bycatch, which could result in the premature closure of the access area.

Methodology

The solution sought out by the NE scallop sector was to introduce a real-time interactive and iterative catch and effort information system to their fleet. As a result, in collaboration with The Coonamessett Farm Foundation Inc. (hereafter referred to as CFF), OLSPS International (hereafter referred to as OLSPS) was contracted by the NE scallop sector to provide a customised version of its, widely used, Olrac commercial fishing eLog technology. The technology OLSPS used to develop the Bycatch Avoidance Solution was based on its Olrac data management system, an advanced electronic logbook and reporting technology specifically designed for the global commercial fishing fleet. The Olrac system can manage the entire flow of data and reports from vessels at sea to the management hubs on shore.

The Olrac eLog system is comprised of two main components: a vessel unit named Olrac Dynamic Data Logger (OlracDDL) and a fleet management unit named Olrac Dynamic Data Manager (OlracDDM) (Fig. 1). OlracDDL is a highly customizable vessel-based electronic logbook system. Data collected by the Olrac eLog system includes relevant fisheries, biological, environmental, and vessel crew data. A core component of this unit is a GIS system where vessel movements are continuously tracked, and fishing activities are marked and reported. Recorded data and compiled summary reports can be transmitted to shore-based management hubs, be it port authorities, compliance agencies, or management officials, in real-time, by making use of the vessel's Wi-Fi, cellular, or satellite communication systems.

The second component of the Olrac system is the OlracDDM, a web-based application which can manage, store, analyse, and distribute data and reports from a fleet of vessels at sea, be it at a company level, a whole association or even an entire national fleet. Vessels' locations and movements can be displayed, and reports can be scrutinized in real-time.

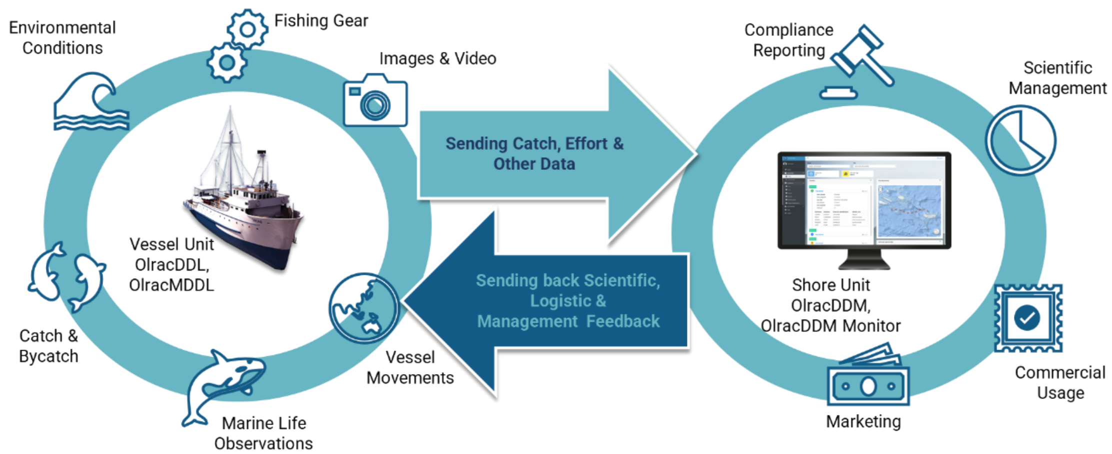


Figure 3: Olrac eLog system overview.

Results and Discussion

The result is an end-to-end bycatch avoidance software tool based on the widely used Olrac commercial fishing eLog system. The OlracDDL is used to record and report bycatch CPUE and send them to the shore unit, the OlracDDM, which is used to aggregate reported CPUE data and convert these CPUE data to a fleet-level assembled spatial density map. These aggregated CPUE maps are then sent back automatically to the fleet fishing vessels at sea (Fig. 2). No data source or source data are presented, only the aggregated summary CPUE map. Vessels at sea are notified automatically by their OlracDDL units that new maps are awaiting their approval and, once acknowledged by the user these aggregated bycatch CPUE density maps are automatically incorporated into each vessel's OlracDDL GIS utility. This allows fishers to view bycatch CPUE maps while still at sea and use them to avoid areas of high bycatch. The Olrac Bycatch Avoidance Solution allows CPUE data to be aggregated according to different time periods (hours, days, weeks, or months). The Olrac solution allows the system administrator to manually, or the OlracDDM automatically, based on set predefined rules, send out maps which reflect different time periods and different dates. As such, bycatch maps can be viewed and analyzed both spatially and temporally. Fishers can then use these maps to navigate their boats around areas of high bycatch CPUE likelihood.

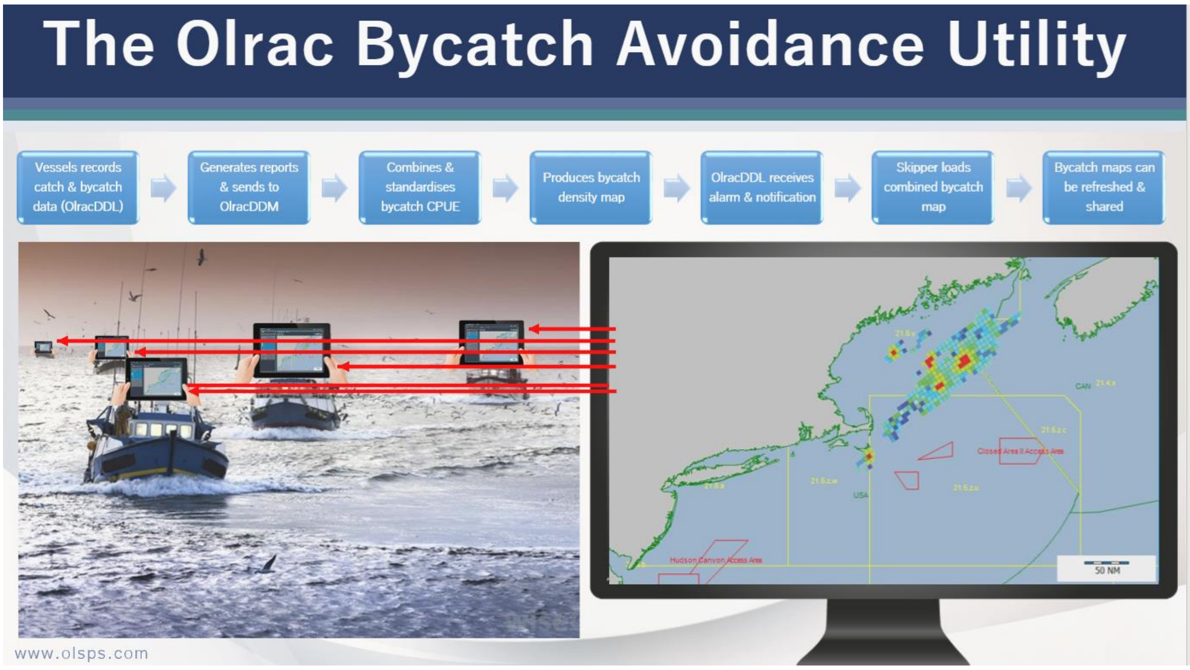


Figure 4: Olrac Bycatch Avoidance utility developed by OLSPS.

Abstracts of oral presentations that did not provide Extended Abstracts

Artificial Intelligence (AI) models developed from electronic monitoring video automate detection of catch in the Hawaii longline fisheries

Joshua Tucker

National Oceanic and Atmospheric Administration, United States

Artificial Intelligence (AI) models have the potential to save cost and time for video review of electronic monitoring (EM) data through the automatic detection of fishing vessel catch events. Research is ongoing in the Hawaii longline fisheries to automatically detect catch events including bycatch that are released from fishing gear without being brought on board the vessel. To train AI models, a library of annotated images of fish and protected species (sea turtle, cetaceans, and oceanic whitetip sharks) is being built. EM video is currently collected from 20 volunteer vessels, and images of catch on both the deck and in the water are extracted. Annotations are created by drawing bounding boxes around catch using VIAME dive desktop software. These annotations and their associated images are incorporated into a YoloV5 object detection algorithm for training, utilizing the compute power of virtual machines and google cloud. Successful AI models have been developed which detect fish on deck and sea turtles on deck and in the water using 86,000 annotations. Model performance metrics and tests from running raw video footage through model algorithms indicate good accuracy and confidence with minimal false positives. Future work will focus on improving models by experimenting with adding annotations of sea turtles from a gillnet fishery, annotating common false positives (e.g., buoys mistaken as sea turtles), and correcting annotation mislabels. In the future, annotations of EM imagery of longline caught fish in the water and annotations of cetaceans from video collected by at-sea observers will also be added, as these interactions are rare and imagery from our EM vessels is limited. When there are sufficient annotations, models which detect fish and protected species will be built from EM video of both water and deck views to provide a more comprehensive view of catch.

Using observer data to understand, predict, and avoid Chinook salmon bycatch

Kate Richerson

Northwest Fisheries Science Center, United States

The unintended catch of non-target species presents challenges for fishing operations, fisheries managers, and conservation efforts. On the US west coast, bycatch of Chinook salmon is of particular concern, because Chinook are culturally, ecologically, and economically important species subject to much conservation concern. Though rates of Chinook bycatch in the Pacific hake fishery are low, the high volume nature of this fishery means that overall Chinook bycatch has potential to limit the fishery. Observer data plays a key role in quantifying and mapping this bycatch, with daily observer data being analyzed and disseminated to the fleet by a third party, Sea State, Inc. This lets the fleet get near-

real-time information on bycatch hotspots, so that they can rapidly implement bycatch avoidance strategies. In addition to this real time use of observer data, we are using spatiotemporal modeling methods to test our ability to predict future bycatch based on environmental correlates. We find that some models can do a good job at predicting future bycatch, especially at short time scales, and that avoiding a small number of fishing locations could potentially result in relatively large reductions in bycatch. Finally, we are using observer data to elucidate ecological mechanisms that may impact bycatch rates. We show evidence that bycatch rates are influenced by diel vertical migration and by temperature, and that these mechanisms can vary across stocks. These efforts show how observer data can help fleets avoid bycatch in real time, while also increasing our ability to understand and predict bycatch patterns.

Open Discussion Session

Carolina Breakell to Amos Barkai:
Q: Did the scallop sea farm fishermen request data to compare their own self-reporting data with the observers' data in relation to yellowfin flounder catch?
A: The fishermen told them exactly what kind of data they wanted to collect including compliance and information data. They collected the data not to write a report, but to collect bycatch data for the skippers to use directly for their own commercial benefit to avoid the flounder.

Q: Are they still using the data?
A: No, and that is a sore point. There is a big fight between NOAA and the fishermen about who should fund part of the technology and if there should be commercialization of that technology and who gets the data.

Malo Hosken to Joshua Tucker:
Q: There was an error in the turtle software where it misidentified a float as a turtle. Why did that happen? Did you train the model to recognize floats? In regards to counting floats in that fishery which observers do, why was there the misidentification?
A: Joshua Tucker: We have not completely trained the model to identify floats yet, but that will happen and we are going to annotate those and put them back into the model as false positives so the model recognizes floats as objects. The model detected it because it was a circular object that resembled a turtle.

Dave ?? to Joshua Tucker:
Q: You said it take 7-8 days to train the model, my question is how often do you train the model and what constitutes a training?
A: We are in the fourth or fifth iteration of training and have been using the same size dataset and different sizes of model detection to see if we can get a more accurate model. We are currently building more annotations to restart our training with the same object detection algorithms to improve the training.
Q: Once you have a model you're comfortable with, what would trigger a new retraining of that model?
A: Performance evaluations would trigger that and if the model isn't doing what we want we can create annotations to train it and make it work better.

James Clark to Stephane Thanassekos:
Q: There was a chart comparing observer data to vessel data in the krill fishery and how its improved, and he's asking what the x-axis was for that chart?
A: It was the frequency of occurrence of fish in the bycatch between 0 and 1.

Amanda Barney to Joshua Tucker:
Q: For the development of the AI models that you conducted, was that done internally or with a third party and if so could you elaborate on the arrangement you had?
A: Joshua Tucker:We worked initially with our contractor Deloitte and their AI team for about a year setting up our training environment. We adapted tools and they taught us how to do the trainings and now all of the trainings are now done by us.

Jennifer Stahl: We don't have that expertise in house so we looked at them to train us and as we built our model we can do additional AI trainings because we want to be able to detect turtles, cetaceans and protected species in the water, but with our short contract with them we only had the data to do annotations of fish on deck. So we wanted to be able to build upon the model as we got more annotations and now we are doing the annotations and trainings ourselves and are able to move forward on our own.
Q: How much does this cost, who is paying for it and are you looking at how much time its saving you in your program and is it a cost saving method?
A: Joshua Tucker: The fisheries information people at our headquarters are the ones who set this up and we are still in research and development mode and we are not a compliance EM program so those cost analyses have not been completed.
Jennifer Stahl clarifying the second question: You're asking how much does it cost to do the AI and why are we pursuing the AI with the EM?
Amanda Barney: As an EM provider one of the considerations is how much will it cost to set up an algorithm and model and what will it cost to maintain that model over time and how often do you need to validate it. Since you are doing all this I think it's very good information for other programs to understand what it would cost especially in the initial phase of taking 7 days to retrain the model and what are the long term infrastructure costs so people can get a sense of what that looks like over time based on the requirements of the model and compare that to existing delivery costs. And is there a cost benefit in a model like this to be used in every region or fishery.
A: Jennifer Stahl: We have an EM technology steering committee and we are going to be working on costs for having EM in general, but are still in the early stages with the machine learning and we're starting to outline that process so hopefully in the next 6 months to a year we'll have a document that shows those results of cost analysis.

Jamie Gibbons to Joshua Tucker:
Q: About the image library for the annotations- who owns the image data, what is the original source of that data and are there any rules and regulations about sharing that image data either raw or annotated with others who are looking to build similar models?
A: Our annotation image library is all collected from in-house from our EM systems in Hawaii longline fisheries. So currently we are the managers, owners, operators and custodians of that data. There are other resources of annotated images; the nature conservancy has a nice collection of annotated images that people use. We have protected species annotations that are highly coveted but with our current privacy policy the images are sensitive information that we can't share.

Jennifer Ferdinand to Kate Richardson:
Q: Was your predictive capability different for the various Chinook stocks of different origins specifically between wild caught fish?
A: For the second project I talked about we didn't do any cross validation, in general there is higher uncertainty due to smaller sample sizes of subsets of the data that has been genetically tested and is attributed to particular stocks. It's a lot more challenging to do on a stock-by-stock basis.

Steve Kennelly to Amos Barkai:
Q: If that system works well between the 15 boats then in short time there shouldn't be any more records of yellow tail flounder being caught, because if that data is shared in real

time then they'll avoid those places and that should lead to a decline in the reporting of flounder caught, did you notice that or is anyone looking at that?
A: There is always tension between the main catch, the target catch and the bycatch. For the fisher making economic decisions a certain amount of bycatch is allowed, so if there's a good catch of scallops, then having some bycatch is inevitable and they will never totally avoid all bycatch if the target catch is good. So there will still be reporting of bycatch species with their method of fishing.

Paul Oryem to Jennifer Stahl:
Q: Are you able to speciate turtles and specific cetacean species and once you have a certain number of protected species takes in those fisheries are the fisheries shut down?
A: We had two separate EM deployments and with the second deployment we had improved resolution and camera views and were able to speciate turtles in all of those. With the cetaceans we only had 2 observations as they are pretty rare and when the cetaceans are far away and not pulled close to the vessel it is harder to identify them. But when they are pulled close to the vessel as per protocol we can identify them with the camera resolution.
Your second question was about closures, yes there are closures for sea turtles and that's another thing we have to think about; if we are to put that in an EM program how are we going to do that with the existing regulations and management protocols.
Q: Can you say what species of sea turtle you see?
A: We see leatherbacks, loggerheads most commonly also greens and olive ridley's and hawks billed. We were able to ID the leatherbacks from their long pectoral fins.
Q: Are you comfortable with those ID's and what level of certainty do you need to make that ID?
A: NOAA uses a table to ID turtles and choose a probability of mortality based on the injury category and release condition of the turtle if it is trailing gear and if it is a hardback or softback species. Most of the sea turtles had high certainty in the probability of mortality because we could see the injury category and release conditions generally, but in some circumstances we were taking more conservative estimates from that table when we could not be sure if the trailing gear was greater than half the body length or where it was hooked. If the handling was done in view of the camera we had a better chance of estimating the probability of mortality more accurately.
Q: When you brought in the consulting company what was your current expertise and how did you go about setting up that Google cloud platform and did the consulting company do that for you and did you bring in external data to train the model?
A: For the last question our EM program is not used for regulatory compliance, all our compliance is done by our observer program with 100% coverage and relies on the observer data. Deloitte came in and set up our Google cloud platform and all the training involved and through the contract they trained us on how to use it. All the data we use is our own data so there was no external data brought in. There was some initially but we filtered our data to only include our own data.
Q: When you uploaded your platform was that something you did on your own?
A: NOAA has people to manage the Google cloud platform and in the GCP hardware updates in the region you can us a drop down to update that way. There is a much faster GPU to use but it was not available for us to use.
Q: Does Google now own the algorithm and will that ever be open sourced and available for public use?

A: The yellow v5 is open sourced and available and the training data and outputs from that are ours and the distribution of that hasn't been talked about.
A: Jennifer Stahl: This is still a work in progress and a discussion for the future because we still need to improve in somewhat. We did have some external training data on sea turtles from the gill net fishery we were going to use to help us improve our model because we have limited sea turtle video since they are rare events and we need to set aside some of that data when training so you can run validation. We also received some video from the observer program on cetaceans of video taken by observers that we're going to use to train for cetaceans since we have limited interactions with cetaceans from our EM videos so we are going to try and use some external imagery as well. You asked if we had any expertise when starting out and I can say not really, we're biologists and its good to have biologist talk to the technical experts to get what we needed done and have that connection to the technical experts.

Claus Reedtz Sparrevohn to Stephane Thanassekos:
Q: After 2022 there was much more alignment between the samples taken by the vessels and the observer program and was wondering how that came about or if that was due to changes in sampling or whether they were asked to be more accurate?
A: There are a lot of things going on there including that the observers' requirements changed over time. They have been required to report more and their coverage was ramped up to 100% and the ramping up of coverage happened in that time series. Regarding the comparison to the vessel there are other confusing things going on including some vessels who decided to just copy the observer data and use that, giving you a perfect match in samples. So there are a lot of things happening within this data in these different countries with different practices including the progressive dominance of continuous trawlers. In the krill fishery there used to be the traditional trawlers and now there are trawlers with a different kind of data collection method of every 72 hours instead of every haul. There are a lot of things going on with the data, but trying to look at the convergence of observer and vessel data is what can be used by managers to decide whether they want to change management and give new guidelines.

Claus Reedtz Sparrevohn to Kate Richardson
Q: How were the new results received by the industry and have they changed their fishing behavior?
A: At this point this is an academic exercise and we're going to produce the results at their industry pre season meeting in April and a lesson learned would be to involve the industry earlier. In the past they've said to me that they know how to avoid Chinook so they have a good sweep of bycatch avoidance techniques already and they don't think they need more as long as they're staying under their threshold. I did talk to Sea State, the company that contracts with them, and they were fairly interested in some of these predictive models so we'll see if it's useful for them to incorporate them.

Jennifer Ferdinand to Phil Ganz:
Q: Given that neither the pessimistic or optimistic models have drowned out the monitoring effect in less than 100% could you still use either model to inform some level of coverage that would minimize it?
A: Yes and I think that was the goal of the study because often when we're interacting with the north Pacific council there's this assumption that we see monitoring effects but if we

just increase coverage they'll go away, but that has never really been evaluated. That was the goal of the analysis and the purpose of those two assumptions was to get bookends and its very specific to the way that we test for observer effects. There are different ways of testing for them and the study we did says is that if you're going to use these tests with these metrics we would expect the observer effects to go away between these two book ends.

Eric Brassuer to Amos Barkai:
Q: This could be something given the competitive nature of east coast fishers that they could use this reporting to scam the system and I could see them indicating that they had extreme bycatch to keep others out of the area, and secondarily this could be a way to get more buy in with fishers working with observers if we could find ways to integrate aggregated bycatch data in real time reporting to vessels and finding a way to share that data and have more trust and be able to fish better. Thoughts on those different things because it sounds like that's what you're interested in and your main goal is to find ways for observed data to be shared and be commercially viable.
A: Yes that's a question that I get in many different forms all the time and it depends on the integrity of the person whose using the data. The idea is to not really spy on the fisher the idea is to get his cooperation and in this particular case the skippers were selected because they were willing to participate. If they were to misreport they would shoot themselves in the foot because the season would close if there's just one bad apple who didn't correctly disclose bycatch and the whole fleet and season would suffer because they would close the season at the moment the estimations of yellow tail flounder bycatch got too high.
Q: Are they closing the fishery based on the logbook estimations?
A: They would close the fishery the moment the estimated bycatch of flounder reaches a certain point. No matter if it's by one vessel or by several and whatever data they're using to report to NOAA or whatever legal means they've been using. The other thing is I'm supporting connection of observer data and technology and I think our technology should be used by observers to accurately collect a lot of information and use it for many purposes, and they can complement each other and increase the integrity of the data. We need to bring a lot of technology together, they need to complement each other and we need to continuously improve the technology and somebody needs to pay for it.

Dave Colpo to Kate Richardson:
Q: The downside of predicting in the future is not only where the salmon will be but how well does the model predict underlying variables that it needs like sea surface temperatures and how well does it predict that and has any work been done on that?
A: That's a great question and the way we designed it is to use lag environmentally sensed variables because we didn't want to have to predict those variables so in theory you don't have to use any environmental predictors you would use the data you have today to predict variables for next week assuming conditions now will be similar to next week. The downside is next week could be different than it is now but we thought that would be a good starting place. So where we are now is just using static lag variables as predictors.

Christopher Cusack to Kate Richardson:
Q: To what extent would the use of in situ collected observing data add value to your model?

A: I think that would really interesting especially for the mechanistic models, we have this theory that Chinook are going deeper in the water column to find their preferred habitat but we don't have any way of testing that if the water is actually cooler, were just going off of sea surface temperatures, so something like a temperature logger on the net would be super cool if anyone knows how to make that happen?
Christopher Cusack: I do and I'll talk to you about that.

Christopher Cusack to Phil Ganz:
Q: I see that the monitoring effect goes away after a certain sampling threshold, what is the mechanism for that and why does that happen?
A: With the optimistic assumption that we're drawing more monitored trips those means move closer together and it becomes not a rare event and that's part of the definition for it going away, so it hinges on that assumption and we didn't see it go away when we were drawing from those monitored trips.
Q: I guess my question is more what's going through the fishermen's head?
A: We don't know how the fishermen are going to respond. This was our attempt at simulating how they would respond, so we were just taking the raw data and saying what are some ways they would respond and lets get the two ends of what might happen.

Craig Franz to Amos Barkai:
Q: I like this idea of peer-to-peer data sharing because these guys might trust their peers rather than the federal government or agency. Could you tell us more about how I could use an industry system to get peer data sharing and how can we get to a point where quality data is shared without the fear of the government spying on that data?
A: Yes if you want to get my email I could send you a copy of a project I just finished funded by the OPS space agency dealing exactly with this issue on a private study on how to send data in a completely invisible way to the data analyzer and to be used only in-house. For example if you want to know where there is a high level of bycatch CPUE everything else is completely confidential there is a whole platform where you can share these analysis that was done in response to increased demand for data confidentiality. I will be happy to send you a copy of this document that addresses this issue.

Amanda Barney: Adding comment: If you want fishermen to trust you then create that trust with them and be honest and transparent about your management plans and be inclusive in how your designing programs and that's my insight in the collapse of the cod fishery- why weren't we included in dialogue, why didn't we know what was being managed offshore. They will trust you if you generate trust with them.

Poster Presentations - Extended Abstracts

Utilizing Observers and Data to Monitor for Presence and Proliferation of Invasive/Non-Native Species and Shifts in Population and Unusual Occurrences

Phillip Bear

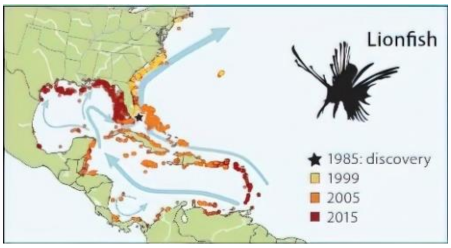
A.I.S., Inc Galveston Shrimp and Reef Fish Observer Program

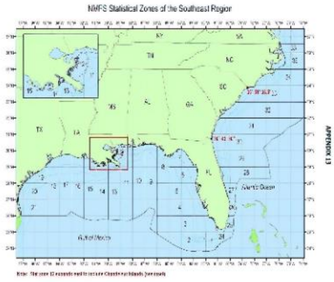
The emphasis on data collected by fisheries observers has primarily been on targeted species, bycatch, and interactions with protected species. Fisheries observers are uniquely positioned to document and record additional data on species and behaviors encountered while deploying on commercial fishing vessels.

Observers could be trained to recognize invasive or unusual species to collect data and specimens when these species are encountered. Efforts would be coordinated with local fish and wildlife officials, universities, and fishermen to acquire more data to allow a better assessment of the population of these invasive species and the potential impacts they may have on native populations.

For example, in the Gulf of Mexico and the southeast Atlantic coast of the US, lionfish, (*Pterois volitans*) and Asian tiger shrimp (*Penaeus monodon*) are two invasive species have been documented and are regularly encountered by observers. Commercial fishing boats operate and capture these species in areas not regularly surveyed by other scientific organizations, and in some cases, where surveyors can't reach, such as in depths beyond the limits of scuba divers. The additional information collected by observers would be useful in determining the population dynamics of these invasive species. The data collected by observers would also help determine if their populations and range are increasing, which would help further assess the impacts on the ecosystem and fisheries.

Asian tiger shrimp (*Penaeus monodon*) and red lionfish (*Pterois volitans*)





Range of the Asian tiger shrimp (Fuller et al.)(left), red lionfish (US Forest service) (middle) in the southeastern US and Caribbean. To the right is a chart showing the statistical zones of coverage for the Galveston shrimp and reef fish observer program (NOAA.gov)

Fisheries observers are also in an excellent position to be the first to record shifting populations of native species. For instance, as sea temperatures rise, it can be expected that populations of native species to move into or away from areas of commercial fishing operations. Data collected could be used to determine whether unusual sightings are just a rare anomaly or a trend toward a shifting population. Determining the potential for major changes in targeted commercial species, and what these changes are could help define new regulations to ensure the sustainability of these fisheries in the future.

Reporting and documenting of diseases, infections, or parasites detected in the catch or wildlife associated with fishing activities would be highly valuable in fisheries and wildlife management. These detections could serve as an early warning to allow officials to implement measures to mitigate the potential spread of these diseases and protect the public from potential health hazards. This would be especially important in instances where these infections are detected in areas with fish farming operations in close proximity. The transmission of diseases from the wild to individuals in holding pens could have devastate fish farming operation, and an early detection could help limit the potential damage to the stocks. These detections will help determine if infectious diseases are originating from nearby fish farm facilities, especially when an increase in infections are noticed in wild populations after fish farming activities are started in the area.

Observers in several programs are already trained to recognize some diseases, such as fibropapillomatosis, that afflict sea turtles and take appropriate precautions to minimize contamination. Proper training in recognizing other potential diseases would help in determining the range, impacts, and potential solutions to these issues.

Green sea turtle (*Chelonia mydas*) left, infected with fibropapillomatosis (source Science.org) and common bottlenose dolphin (*Tursiops truncates*) with an apparent skin infection.

Observers could also contribute useful information by documenting behaviors witnessed by wildlife associating with fishing vessels during fishing and non-fishing activities. Interactions with fishing operations are already a crucial bit of data observers collect, namely feeding on catch and discards. These interactions put wildlife, namely protected species, at risk of potential harm during these interactions. But in addition to those risks, fishing operations can affect the natural behaviors and impact the rest of the ecosystem. For instance, predators such as sharks, cetaceans, pinnipeds, and sea birds often prey on weaker individuals. Feeding on captures and discards instead could potentially have negative impacts such as allowing their natural prey items to proliferate to exceedingly high numbers in addition to endangering the predators from their interactions with the fishing vessels and the gear. It would also be important to note if species such as mammals and birds are teaching their offspring to associate with these vessels as a food source instead of the natural prey items. Negative impacts on top tier, apex predators could have a cascading effect down the food chain that could potentially disrupt entire ecosystems, which would impact species targeted by fishing operations. Collecting data on a wider range of interactions and behaviors would help with assessment of detrimental impacts and help implement measures and regulations to minimize the potential damage from fishing activities.

Analyzing Trends in U.S. Commercial Fisheries Bycatch and Evaluating Solutions to Global Bycatch Problems

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Introduction

Sustainable fisheries management requires that the bycatch of fish and protected species (Figure 1) be estimated, tracked, and minimized to the extent practicable. In U.S. commercial fisheries, data on levels of bycatch - or the discarded catch of any living marine resource - are primarily collected by independent fisheries observers. NOAA Fisheries is responsible for ensuring adequate data collection for high-priority bycatch species, and for producing bycatch estimates using the best scientific information available. Not only are high-quality bycatch estimates important to U.S. fisheries management, but the Food and Agricultural Organization of the United Nations found that global assessments of fisheries bycatch can be improved by increased reporting of bycatch by species and gear type from data poor regions (Pérez Roda et al., 2019). In 2011, NOAA Fisheries published the first edition of the U.S. National Bycatch Report (NBR), which contained bycatch estimates for fish and protected species by region (using 2005 data), descriptions of bycatch estimation methods, and data and estimation method quality scores (NMFS, 2011). The authors of the NBR recommended that NOAA Fisheries monitor bycatch trends over time for key fish and protected species groups (which may be stocks, populations, species, or aggregations of multiple species) that have high bycatch levels, special importance to management, and/or have stock status concerns (e.g., are listed under the Endangered Species Act (ESA) or overfished according to the Magnuson-Stevens Fishery Conservation and Management Act)). Although updated bycatch estimates for these key stocks have been published in regional NOAA Fisheries Technical Memoranda (e.g., Soldevilla et al., 2021) or as part of subsequent editions of the NBR (NMFS, 2013a; 2016a; Benaka et al., 2019), a bycatch trend analysis to demonstrate how well NOAA Fisheries and its Regional Fishery Management Council partners are meeting bycatch reduction goals on a national scale is outstanding. The overarching goal of this project is to take initial steps toward conducting bycatch trend analyses that could help demonstrate how the United States is meeting bycatch reduction goals. Specifically, is it possible to detect trends in fish and protected species bycatch within a fishery using available data?

Figure 1: Example images of bycatch species in fishing gear. (Left) Large shark being returned to the sea by the crew and officers of NOAA Ship Miller Freeman. (Top right) Entangled subadult humpback whale (Image taken under NOAA MMHSRP permit # 932-1905). (Bottom right) Hooked sea turtle (NOAA Fisheries Pacific Islands Fisheries Science Center, PIFSC MTBAP Permit # 21260).

Methodology

For this presentation, we analyzed bycatch trends for ten species, and presented results for six species (two per region), in three different fisheries with relatively high levels of observer coverage:

- Hawaii-Based Deep-Set Pelagic Longline fishery: Bigeye tuna (*Thunnus obesus*, a commercially valuable stock that has rebuilt after hitting low population levels in 2004) and Laysan albatross (*Phoebastria immutabilis*, listed as "near threatened" by the International Union for the Conservation of Nature[6]).
- West Coast Limited Entry Bottom Trawl; Midwater Hake Trawl fishery: Pacific hake (*Mercluccius productus*, a commercially valuable stock) and blue shark (*Prionace glauca*). While we prioritize monitoring trends for endangered species like the pelagic thresher shark[7], many rare species are only observed as bycatch during one or two years, and so a trend analysis is not possible. Instead, we performed a trend analysis for the blue shark since it was observed more frequently in the data set. We have not yet compiled data for marine mammal, sea turtle, and seabird bycatch species for this fishery.
- Atlantic Highly Migratory Species (HMS) Pelagic Longline fishery: Loggerhead sea turtle (*Caretta caretta*, listed as threatened under the ESA) and Risso's dolphin (*Grampus griseus*, protected under the Marine Mammal Protection Act).

In selecting fisheries and species for this analysis, we also tried to maximize the length of the time series and minimize changes in bycatch estimation methodology over time. Typically, the NBR has included bycatch estimates for over 800 bycatch species or species groups from over 100 fisheries or grouped fisheries, so the results presented here represent a small subset of observed bycatch over time in U.S. fisheries.

We compiled annual bycatch estimates from NOAA Fisheries regional databases[8] and published sources (McCracken and Cooper, 2020; NMFS, 2021), created time series plots using the base R plot() function, and then added a smooth line to visualize the trend with the lowess() function from the stats package. Using the R package Kendall, we applied the Mann-Kendall test for significance in trend (Mann, 1945; Kendall, 1975), which statistically

[6] *Phoebastria immutabilis* is listed as Near Threatened under criteria A4bd. https://www.iucnredlist.org/species/22698365/132643073

[7] Pelagic Thresher *Alopias pelagicus* has most recently been assessed for The IUCN Red List of Threatened Species in 2018. *Alopias pelagicus* is listed as Endangered under criteria A2bd. https://www.iucnredlist.org/species/161597/68607857#assessment-information

[8] https://www.webapps.nwfsc.noaa.gov/data/map

assesses if there is a monotonic upward or downward trend in the variable of interest over time, which may or may not be linear. We then designated each bycatch estimate time series as increasing, stable (non-significant trend), or decreasing for the selected stocks. For this analysis, we used an alpha significance level of 0.05, but we will need to adjust the probability values for multiple testing when evaluating the full set of bycatch species and fisheries.

Results and Discussion

The ten bycatch trend analyses yielded three significant increases, one significant decrease, and six non-significant trends. The Hawaii-Based Deep-Set Pelagic Longline fishery (Pacific Islands Region) primarily targets tuna, and the bycatch estimation methods (generalized ratio estimator, Horvitz-Thompson estimator, and synthetic estimator added for 2020) have changed little throughout the time series. The trends for swordfish, giant manta ray, and loggerhead turtles bycaught in the deep-set pelagic longline fishery were all not significant (data not shown). The bycatch trends for bigeye tuna and Laysan albatross increased significantly between 2005 and 2020 (Figure 2).

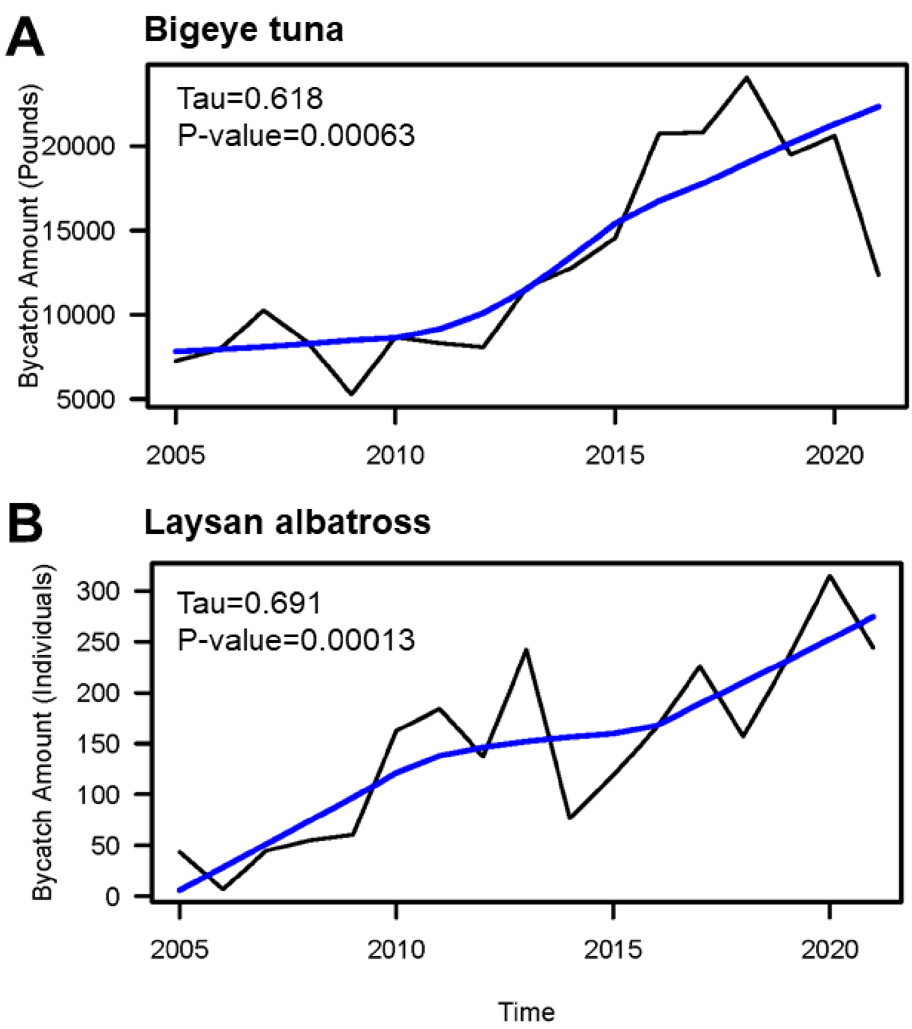

Figure 2: Trend analysis for bigeye tuna (A) and Laysan albatross (B) bycatch in the Hawaii-Based Deep-Set Pelagic Longline Fishery. The Kendall's tau statistic and two-sided probability value (p-value) are shown. The black line connects the actual bycatch estimates

and the blue line shows the LOWESS smoother, which uses locally-weighted polynomial regression (Cleveland 1981).

We selected the West Coast Limited Entry Bottom Trawl; Midwater Hake Trawl fishery (West Coast Region) because 100% of trips are observed or electronically monitored. Bycatch associated with any unsampled effort is estimated using observed ratio estimators. Estimation methods have not changed over the time period, with the exception of slight changes with adding electronic monitoring in 2015. Of the two bycatch species trends assessed in this fishery, only Pacific hake bycatch increased significantly between 2015 and 2021 (Figure 3A). The trend analysis for blue shark (Figure 3B) did not detect significant increases or decreases in bycatch between 2015 and 2021.

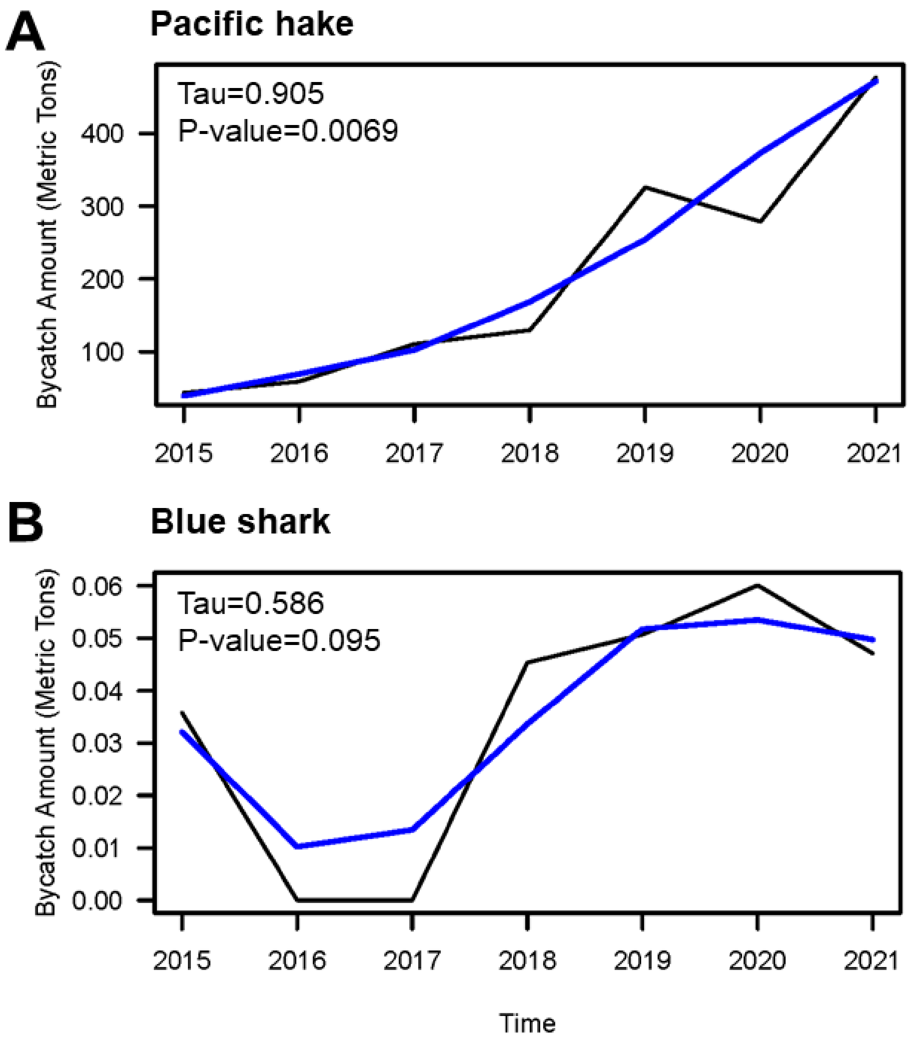

Figure 3: Trend analysis for Pacific hake (A) and blue shark (B) bycatch in the West Coast Limited Entry Bottom Trawl; Midwater Hake Trawl fishery. The Kendall's tau statistic and two-sided probability value (p-value) are shown. The black line connects the actual bycatch estimates and the blue line shows the LOWESS smoother, which uses locally-weighted polynomial regression (Cleveland 1981).

The final fishery we included in this preliminary analysis was the Atlantic Highly Migratory Species (HMS) Pelagic Longline fishery. Bycatch estimation methods for this fishery have not changed over the study period, and include the stratified delta lognormal estimator (marine mammals and sea turtles), delta lognormal (fish), and delta lognormal model based estimator (seabirds). Of the three species we evaluated in this fishery, only the bycatch trend for loggerhead sea turtles decreased significantly between 2010 and 2020 (Figure 4A). The bycatch trend for leatherback sea turtles (data not shown) and Risso's dolphin (Figure 4B) were not significant. However, the Risso's dolphin trend does appear to be generally decreasing prior to the most recent year of data.

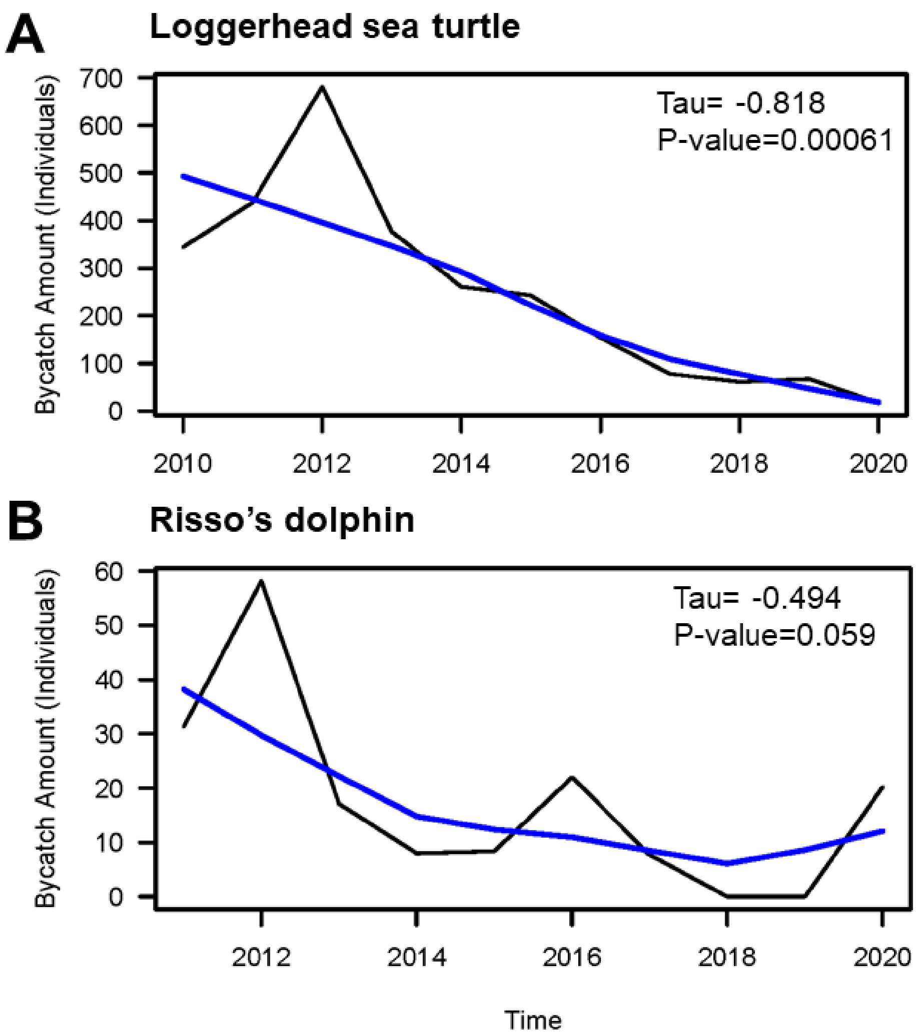

Figure 4: Trend analysis for loggerhead sea turtle (A) and Risso's dolphin (B) bycatch in the Atlantic HMS Pelagic Longline fishery. The Kendall's tau statistic and two-sided probability value (p-value) are shown. The black line connects the actual bycatch estimates and the blue line shows the LOWESS smoother, which uses locally-weighted polynomial regression (Cleveland 1981).

NOAA Fisheries is able to analyze bycatch trends and take responsive management actions because it has prioritized the development of robust observer programs for major U.S. fisheries. For this preliminary analysis, we examined trends in estimated total weights or numbers of select bycatch species within a given fishery over time. While trends in estimated total bycatch amounts provide useful information about impacts to marine resource populations, these trends need to be standardized in order to assess the effectiveness of bycatch reduction measures. Subsequently, we will analyze trends for additional bycatch species from all regions of the U.S. that meet our minimum data requirements to look for cross-regional changes, e.g., impacts from climate change. Our team will work with bycatch data analysts in all NOAA Fisheries regions to standardize bycatch estimates using fishing effort data, such as the number of fishing trips, sets, and/or hooks recorded by fishery observers, EM, and logbooks, if available. We will also consider other potential confounding factors that could influence observed bycatch trends, including changes in the precision of bycatch estimates, observer coverage levels, species distribution shifts, and spatial shifts in fishing effort. Then, we will look for drops in bycatch per unit effort following the implementation year of bycatch reduction measures.

In order to develop solutions to bycatch problems that will work for diverse fisheries, species, and governments, we are in search of international collaborators with similar data sets. We hope to work with our international coauthors to identify lessons learned from successful bycatch-reduction programs, and evaluate applicability towards remaining high bycatch stocks in the United States and internationally. By increasing bycatch data accessibility, applying appropriate statistical analyses, and communicating results to fisheries managers, policymakers, and stakeholders, we can accelerate the pace of progress towards reducing global fisheries bycatch.

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Acknowledgements

This work would not be possible without the hard work and dedication of the fisheries observers, managers, and scientists from U.S. observer programs in the Greater Atlantic, Southeast, West Coast, Northwest, Pacific Islands, and Alaska regions.

Abstracts of poster presentations that did not provide Extended Abstracts

Using deep learning with electronic monitoring to improve data for catch estimation in fisheries in Alaska

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Alaska Pacific University, United States

The management of fisheries off Alaska relies on accurate estimates of catch weight for assessing mortality against annual catch and overfishing limits. However, length and weight information for large species, such as sharks, are not easily collected by at-sea observers due to safety and logistical issues associated with on-deck sampling. Estimation of total weight is sensitive to assumptions about average weights, such that incomplete sampling in the fishery leads to biases, particularly in larger species. Electronic Monitoring (EM) of catch presents an opportunity to collect length information that can be used to estimate weights through length-to-weight conversions. Alaska has implemented EM on both fixed gear and trawl vessels to an extent that this information is currently being used in quota management. However, there is some delay between when the fishing trip ends and the reviewed video data are available for inseason management. This study is designed to develop machine learning tools to make video reviews more timely relative to inseason management and to estimate size of fish from videos. We use the Pacific sleeper shark (Somniosus pacificus) as a case study. To test the utility of machine learning technology in the identification of S. pacificus from EM video data, we examined the accuracy of detection, tracking, and classification of a series of custom machine learning algorithms. Results suggest that machine learning has the potential to significantly increase EM processing capability with minimal loss of accuracy for S. pacificus and could be expanded to more species. The next steps are to test measurement tools and integrate this novel data stream into the total catch accounting process at the Alaska Regional Office Catch Accounting System. The algorithms being developed are portable and adaptable to other fisheries around the globe; 32 species are already included in the current algorithm suite.

Discards of cod (Gadus morhua) in the Norwegian coastal fisheries: improving past and future estimates

Hilde Sofie Fantoft Berg, Thomas L Clegg, Geir Blom, Jeppe Kolding, Kotaro Ono, Kjell Nedreaas

Institute of Marine Research, Norway

Routine methods for estimating discards are useful for evidence-based management of fisheries. As our knowledge and understanding of discard sampling programmes develop over time, it is useful to review and update such methods to maintain quality and relevance. Here we present two improvements to the current methodology for estimating discards in the Norwegian coastal fisheries, using cod (Gadus morhua) in the coastal gillnet fisheries between 2012 and 2018 as a case study. Firstly, we present a revised methodology for current years which accounts for variations in discarding between vessels and uncertainties in the conversion of numbers to weight discarded. This new methodology estimates an average discard rate of cod (weight of cod discarded as percentage of total weight caught) of 0.55% (95% confidence interval: 0.45–0.70%), although discard rates in southern areas were an order of magnitude higher than in northern areas. Secondly, we present an exploratory analysis of the drivers behind discarding using a random forest regression model. Spatial variations and fishing intensity were identified as the most important drivers of discarding. Results from this study suggest ways in which self-sampled data can be used to estimate discards in Norwegian coastal fisheries, and where the accuracy of future estimates can be improved when a higher resolution data collection programme is established.

Session 11. Monitoring artisanal and recreational fisheries

Leader: Luis Cocas

Small scale artisanal fisheries provide an essential supply of protein and income and occur all over the world, ranging from one-man canoes in developing countries to greater than 20-m vessels in developed countries. They typically include a large number of boats and a diversity of fishing systems and gears, operating over wide geographical areas, making it difficult to monitor them for scientific and enforcement purposes, which compromises their management. Similarly, recreational fisheries require consideration in fisheries and ecosystem assessments because their importance has increased considerably as fishing pressure from commercial fisheries has decreased in some regions. However, monitoring recreational fishing is difficult due to the small vessels involved and the highly dispersed nature of the fishing effort. This session focused on exploring these challenges, providing an opportunity to discuss successful experiences and different approaches used. We examined methodological aspects, innovative solutions, the use of alternative sources of information, along with human, social and economic aspects that need to be considered when working in these fisheries.

Oral Presentations - Extended Abstracts

Implementation of electronic monitoring systems (EMs) in Chilean fisheries

Rubén Toro

National Fisheries and Aquaculture Service, Government of Chile.

Introduction

The practice of discarding (unwanted capture) is a problem due to its impact on marine ecosystems and has multiple drivers that include economic, operational and regulatory factors. Our country faced this problem and that is how the General Law on Fisheries and Aquaculture (LGPA) established the use of modern compliance control systems for discard practices on board fishing vessels. It was provided that vessels with a length equal to or greater than 15 meters must install on board and keep in operation, throughout the fishing trip, an Image Recording Device (DRI) that allows detecting and recording any discard action and any action that constitutes illegal fishing that may occur on board. Additionally, the LGPA establishes procedures and sanctions for events of non-compliance with the regulations that regulate discarding and bycatch fishing, based on the control powers established in the same law.

SERNAPESCA implemented by Law* in January 2020 a delayed electronic monitoring system through video cameras in the Chilean industrial fleet (greater than 18 meters in length) of purse seine (two pelagic fisheries), longline (one demersal fishery) and trawling (five demersal fisheries) on 109 vessels with a compliance focus of discards, incidental bycatch and other mitigation measures to reduce unquantified fishing mortality. Chile has a multi-provider ME system and maintenance services, the cost of the device is the responsibility of the vessel owners, and the image information has a confidential nature granted by Law.

Image Recording Devices (DRI)

The DRI is a control system originally designed to detect and record all discarding and incidental bycatch events that may occur onboard fishing vessels. This system is made up of a set of components such as video cameras, satellite positioning systems, hard drives, and a monitor, among others. Depending on the fishery, the size of the fishing vessels and the type of handling of the catch on board, the number and location of cameras may vary. The images are recorded in high resolution (1280x720p), at 15 frames per second and at a variable bit rate. The video format is MP4 with the H.265 codec, also called HEVC. These characteristics and specifications correspond to a unique DRI technical standard established by SERNAPESCA (compliance agency), which must be accredited by each DRI service provider against an external certifying agency.

The recorded information by the DRI corresponds to images and an associated file called metadata (in csv, Xml or Json format) that contains parameters such as the number that identifies the DRI associated with each vessel, date, time, position, among others. This last information is taken by the analysis software and provides crucial information to record and identify areas of non-compliance, dates, time, inter alia. This last information is taken by the analysis software and provides crucial information to record and identify areas of non-compliance, dates, time, among others. ME coverage is 100% of the industrial vessels and the video review is based on a risk approach and sampling of at least 10% of the fishing sets, obtained through a simple random procedure without replacement.

The DRI in the industrial fleet is a deferred type system and is made up of 3 modules; recording and storage module on board fishing vessels, data collection and removal of hard drives module in port, and an image analysis at processing stations module at SERNAPESCA headquarters in land (Figure 1).

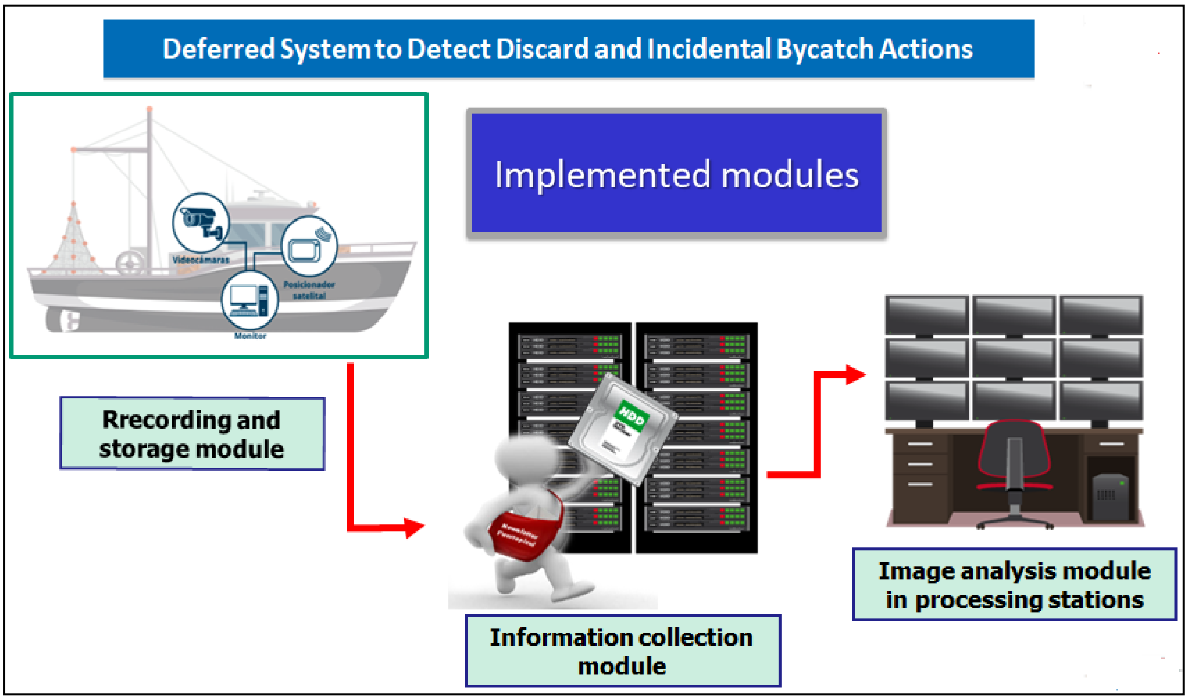

Figure 1. Implemented modules of the Image Recording Devices (DRI) to detect and record discards, incidental bycatch, and compliance with associated regulations in Chilean industrial fishing vessels.

Electronic Logbook System (SIBE)

The Electronic Logbook System (SIBE), correspond to a system for recording fishing information in real time, with a scope for the industrial fleets that operate in the Chilean EEZ. The SIBE is made up of two components; a) SIBE mobile, which is an application compatible with the Android system, available for use on mobile devices (Tablets or Smartphones), which allows the captain of a vessel to record the information of the fishing operations, from the time of departure for a fishing trip to the arrival for landing, along with the estimates of total catch, discarded catch and incidental bycatch for each fishing set, in real time, and b) SIBE web, which is an operating platform for both types of users of the system: vessel owners and SERNAPESCA. For vessel owners, allows to manage their fleets together with managing their operations and access to the records of fishing activities and catch estimates made for their fleets. On the other hand, for the administrator user, which corresponds exclusively to SERNAPESCA, allows to manage and access the global information recorded.

Both components (SIBE mobile and SIBE web), operating in a combined manner, allow registering, submitting, managing and viewing fishing information records in accordance with current regulations (Figure 2).

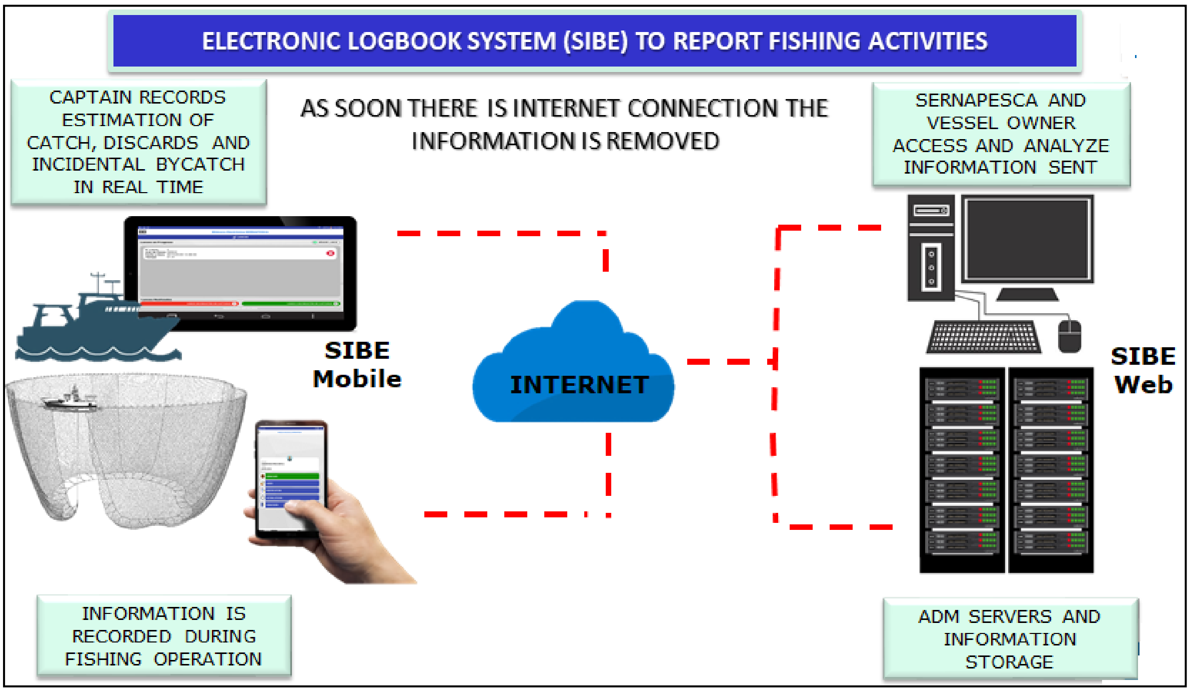

Figure 2. Components of the Electronic Logbook System (SIBE) implemented in the Chilean industrial fleets, to register and manage fisheries information in real time.

Achievements

During the year 2020, more than 100 feedback meetings were held with vessel owners, fishing captains and crews regarding maneuvers and catch handling on board through video conferences in order to report findings, reinforce good practices, correct protocols, adjustments to camera positioning, fishing regulation training and consultations.

This control system has had an impact mainly generating a change in the behavior of fishing crews and captains regarding the discarding of hydrobiological species and management of bycatch. However, there is still a need for greater commitment of shipowners and fishing captains, and with it, a greater concern to record catches accurately in the Electronic Fishing Log (BEP). For the crews, knowing that there are cameras that record the entire fishing trip has resulted in a better management of the catch on board.

The main findings detected by this control system are intentional unauthorized discards associated with bad practices, authorized discards not registered in the fishing log or poorly quantified, retention of species with an obligation to return, and intentional obstruction of cameras.

Artisanal fleet

The installation of image recording devices on artisanal vessels within the scope of the law, whose start date by law*** is from January 2024, covers approximately 500 vessels that register operation, which must comply with the Reduction Programs discards and bycatch in 13 fisheries.

The implementation implies a series of previous works that are related to:

a. Prepare regulations and procedures that regulate the DRI for the artisanal fleet as of January 2024.

b. Generate the dissemination of the DRI regulations to the artisanal fleet through previous meetings with the organizations of artisanal fishermen throughout the country.

c. Support and execute electronic monitoring pilot projects in the artisanal fleet.

d. Generate financing schemes in conjunction with non-governmental organizations (NGOs) to support the implementation of the DRI in the artisanal fleet.

Finally, implement cutting-edge technologies such as artificial intelligence and Machine learning tools, video transmission via Wi-Fi and reviews-analysis through the web, in addition to using the information for research purposes.

* Law No. 20,625 of 2012 on the discarding of hydrobiological species.

** Regulation (D.S. No. 76 of 2015) of the Image Registration Device to detect and register discards.

*** Ley N° 21,259 de 2020 Implementation of the artisanal fleet gradually as of January 1, 2024

Abstracts of oral presentations that did not provide Extended Abstracts

Changing the Paradigm around Small-scale Fisheries Monitoring and Assessment

Christopher Cusack

Environmental Defense Fund, United States

Small-scale and recreational fisheries globally account for approximately half of all fisheries catch and ninety percent of fishery participation. These fisheries are also much more likely than commercial fisheries to lack estimates of fishing effort and catch. This is due to the dispersed nature of these fisheries, a low per-vessel value of the catch that is often not sufficient to support monitoring and ineffective management institutions. This shortfall in fisheries data has contributed to a management paradigm in small-scale fisheries globally that relies on data-limited assessments (if any assessments are conducted at all), high levels of uncertainty and ineffective management measures. The inability to monitor and manage small-scale fisheries effectively will have severe and worsening consequences for food security and livelihood provision as the impacts of climate change are more keenly felt, especially throughout the developing tropics. However, new and emerging technologies have huge potential to change this paradigm by enabling cost-effective monitoring and generating the data needed for effective science-based management in small-scale fisheries. Here we present results and learnings from development of an innovative fisheries monitoring approach called “SmartPass” which leverages shore-based cameras and machine learning to provide fishery managers with near real-time estimates of marine recreational and small-scale fishing effort. We discuss the current capabilities of a SmartPass approach and outline future opportunities to inspire collaboration across the public and private marketplace to stimulate an ecosystem of innovation at the intersection of fisheries management, technology and conservation.

The use of a standardised electronic logbook to monitor the recreational fishery around Saint-Paul & Amsterdam Islands

Charlotte Chazeau

Muséum National d'Histoire Naturelle, France

In addition to the commercial fishery operating around Saint-Paul & Amsterdam islands, in the southern part of the Indian Ocean, a recreational fishery is also monitored. Different type of vessels (scientific and patrol vessels) but also the staff of a scientific station are authorized to catch rock lobster (Jasus paulensis) and fish under the rules established by the administration of the Terres Australes et Antarctiques Françaises. The main issues to be monitored are the compliance with quotas and the integration of catches for fish stock assessment. The development of a standardised electronic logbook appears quickly as the key element of the monitoring tool to collect standardised data on catch: tonnage and localization for each species and also tag recaptures. A simplified electronic logbook has

been specifically designed for users with different background in order to facilitate data input and ensure data quality. It provides:

-a dedicated spreadsheet for species identification

-dropdown menus with standardised references

-conditional formatting for missing values

The data collected are fully compatible with the database hosting the commercial data for this area and interoperability is ensured by the recreational fishery logbook.

Standardizing the catches in on- and off-site interview data from a recreational fishery - what can catches from anglers tell us about fish abundance?

Hans Jakob Olesen

DTU Aqua, Denmark

Commercial fisheries in Europe are in general intensively sampled and monitored. This is quite different for recreational fisheries, where often little information on effort and catch is available. However, as fishing pressure of commercial fisheries has declined in the past couple of decades partly because of declining quotas, the relative importance and potential impact from recreational fisheries have for some stocks increased. For example, recreational catches of Atlantic cod in the western Baltic Sea mounted to almost one third of the catches (before bag limits were introduced).

In Denmark, a data collection program for recreational fisheries with both an offsite (questionnaires sent to a random selection of fishing license holders) and onsite interview survey (interview surveys carried out face-to-face with anglers on fishing platforms) has been running since 2009 and 2016 respectively. The data from the program were in 2019 reviewed during the benchmark for western Baltic cod and are now being used for stock assessment to quantify the contribution from recreational fisheries to the total catches of Atlantic cod in the Western Baltic Sea.

In this study we further explore the effort and catch data with the aim to develop a standardized indicator of the abundance of cod in Danish coastal waters. Data from each survey (onsite and offsite) are modelled separately, and the effect of potentially important variables such as; bag limits, year, season and angler type, are investigated. The resulting models and standardized indices offer novel insight into the factors influencing harvest rates of cod, and allow for a comparison between the information gained from each survey. Such knowledge on abundance of fish in coastal areas, where most of recreational fishing takes place but where the extent of commercial fisheries and international trawl surveys are marginal, is highly needed to improve stock assessment and fisheries management.

Open Discussion Session

Christa Colway to Charlotte Chazeau:
Q: I had a question about the logbooks, there was something called work ergonomics, what was that?
A:That is the way we try to make life easier for the user to facilitate how to use the logbook with drop down menus.
Q: Ok, so it has to do with actually entering data into the application and making it more user friendly?
A: Yes, and therefore to help facilitate the use of the logbook.

Cameron Desfosses to Charlotte Chazeau:
Q: With your method of reporting do you think you're getting 100% of recreational fishers reporting their catch and how much certainty do you have with the biological data being collected. Specifically, it seems that getting lengths down to the millimeter and weights down to the gram could be difficult on a vessel?
A: We are quite confident with the data because the users are mostly scientists collecting at the scientific station and also on the survey vessel they are also scientists so we are quite confident that the use of the new logbook helps a lot because before that there wasn't anything. I think the most difficult part of this is the species identification because they are not always used to seeing these species, but that has gotten easier. We don't ask them to take biological samples because the overall take is less than one ton and this past year they only caught 255 kgs. We really wanted to integrate these recreational catches even though they are very low compared to commercial takes.

Isaac Forster to Marcello San Martin:
Q: We've heard quite a bit that EM in the commercial fisheries in Chile has been widely adopted and considered part of normal fishing practices now, but I'm wondering if you could expand on the challenges in implementing EM into the artisanal fleet? Do you think that because it is quite accepted in the commercial fleet that it will be easier for artisanal vessels to adopt it or do you think there's no overlap between the fishermen of the two fleets?
A: Marcello San Martin: The main challenges in artisanal fleets are finding the right incentives because most of our artisanal fishers fish for local consumption where the market doesn't necessarily require transparency or low bycatch, that would support or encourage the implementation of EMS. On the other hand, for fishers that export to the US for example, it is much easier to bring in these new tools because they have the incentive driven by the market's requirements.
Luis Cocas: For fishers working with local markets, it has been a bigger challenge to get them to accept EM. However, little by little and thanks to the pilot project (supported by TNC) they have begun to see the benefits of being transparent and getting better markets. We've been working ten years to get where we are now and must be patient since this is a progressive process.

Kate Richardson to Christopher Cusack:

Q: I had a question about the Smart Pass system; does that system tell you anything else about maybe the target or individual boats or is it just recording the number of boats going in and out?
A: The algorithms do classifications as well as counting, but the classification is not that well developed yet. So far we can tell the difference between a commercial vessel and a recreational vessel but that's still in development. I think in a lot of situations, the vast majority of vessels going out are commercial fishing vessels and in other situations that's not true, so there's a bit of ground truthing that needs to happen to sort that out.

Caroline Breakell to Charlotte Chazeau:
Q: I know you said previously that a lot of the users are science trained, so as you were training did you spot check for a certain amount of time until you felt confident or did you have someone who was trained check on the trainees?
And my second question is about the ergonomics and the ease of using the database with the drop down menus; have you been able to eliminate the ability to get errors or do you also have code that flags errors if you get impossible numbers?
A: For your first question, yes most of them are scientists, but we do not train them for this specific fishery and species identification because of the costs of this program and we do not know the fishers and we do not get feedback from them. That's why we wanted to add this species identification table in the logbook and it's probably the most critical part of the program because it can be tricky to identify to species.
Maybe we could use one of my colleagues' tools that he presented the other day to try to train them before for species identification to be 100% sure and it's one of the areas that we could improve.
For your second question, we don't have the same integrated tools as we do for the commercial fishery because the total catch is clearly very small so the tool is my brain. The logbook is first sent by the fishers to the French administration and they have the first look and then I receive the logbook and I check it to be sure of the fishing dates, etc. to be sure that it is accurate and then I integrate it into our database.

Tim Jones to Christopher Cusack:
Q: You showed the example of the workings of your system in Indonesia with the blue crab fishery and I was wondering what made you choose Indonesia for that particular test. I'm from the Western Central Pacific Fisheries Commission and we have a great problem with our artisanal fisheries in Indonesia and something like what your advocating would be good. I'm just wondering why you chose Indonesia; was it part of a project or just a good example to use?
A: Yes you're correct, it's a big challenge and the reason we chose Lampung province is because we have an office in Lampung and we have a good relationships with the provincial government and community members and we have a project that's focused with the blue swimmer crab fishery which is an important fishery for export and income generation in the country. We are trying many different ways to improve the management of that fishery and it seemed like Smart Pass would be very useful tool in that fishery.
We've also had a lot of interest from local fishery managers and provincial managers to shine a light on illegal fishing activity and illegal trawl activity that come into ports and managers would like to know when that happens.
In 2019 a port manager was taking 'what's app' photos of the number of vessels coming and going to show that the investments the provincial governments had made in the port

were worth it and paying off, so it is also a way of advocating for investment and infrastructure.
Q: I would like to add that the artisanal fisheries in Indonesia have a huge effect on the national commercial fisheries for the Western Central Pacific fisheries as well as the Indian Ocean particularly on the pelagic stocks, so if we could find out what is happening there it would help with a lot of the stock assessments. But it's a huge task that may never be completed but at least we'll hopefully have some information in the future.
A: Your point is very well taken, thank you.

Glen Chamberlin to Hans Jakob Olsen:
Q: I saw you had a picture of somebody who looked like they were spearfishing for cod and I was curious - do you monitor that activity and if people are spear diving for cod what's the depth they are diving at and what's the annual catch?
A: The guy in the photo is from Spain and a friend of mine and is participating in the spearfishing world cup, so he's diving a bit deeper than the rest of us. We do have the spearfishing covered in our survey but not in the onsite survey. The only onsite survey we have going right now is for the charter boats. We've tried to cover the private boats but there are less access points so it's not feasible with the economy that we have. So the depth he's going to is about 30 meters and staying for 3-4 minutes.

Cameron Desfosses to Christopher Cusack:
Q: We use a similar AI system for our recreational fisheries in Western Australia, but are there any identifiable information on the vessels to actually track vessels or fishing effort to try and get an average for fishing effort?
A: We're not there yet, but we are working in the recreational fishery in the state of Oregon in the western US and those vessels generally have license numbers painted on the boat so there is potential to do that, but we're tossing around the idea that these algorithms can actually identify vessels based on other features but we're not down that road very far yet and I could talk to you more about that.

Steve Kennelly asking Christopher Cusack:
Q: Did anyone do a cost benefit analysis of the benefit of your technology compared to employing locals to go in and write down the number of boats coming and going from the port. I imagine it could be relatively cheap and provide employment in these villages.
A: That's a good question and we did not do a cost benefit analysis in Indonesia and I think it could be a difficult thing to do. I think the big thing about the technological platform that can do this is that it's scalable, and more scalable than using local individuals in the community using training programs and employing people and so forth. We have been talking to the Oregon Dept. of Fish and Wildlife about the economic and financial benefits of using this system and what we heard from them is that there may be no tangible financial benefits that they could employ less people but they could allocate more of that time to doing vessel intercepts.

Josh Wiersma to Marcello San Martin:
Q: Could you say something as to why you chose to develop the EM program using cellular video transfer and what are the benefits you see in doing that?
A: The Patagonian toothfish (or Chilean seabass) fishery is special because they need proof of compliance that they don't have much interaction with bycatch. They were available to

do this study and for us that was an advantage. In the case of the quality of the technological device I'm not sure, SERNAPESCA is the agency in charge of this, but I think one of the problems is the storage of the data and maybe when you use this one it's better.
We also have a lot of harbors so retrieving hard drives is risky and expensive so since we have hundreds of harbors its much easier to use the wireless system than physically removing hard drives and is more cost efficient. In addition, the cell phone coverage in Chile is quite good and most of the artisanal operation is in the range of cell phone signal.

Luis Cocas to Charlotte Chazeau:
Q: What are the challenges in managing and combining commercial and recreational fisheries data since there might be different data qualities?
A: I would say that data quality and accuracy are challenges but we have the chance to be the same team who manages both fisheries so we have the flexibility to manage both the best way we think fits. We also have the chance to develop our own electronic logbook so we can easily choose what we think is the best way to collect data. The other challenges are that we don't have the feedback from the fishers, so we can't be sure whether they like it or not but its quite simple to use. One of the things that we can do is easily adapt because we know exactly what works in both fisheries. Both data complement the same database that I manage so if I have problems in some recreational fishery I can flag them easily and I think that's the best part of the monitoring program.

Luis Cocas to Christopher Cusack:
Q: There's no doubt we need data from artisanal fleets all over the world and I think one of the main data constraints is finding the right incentives to get the data either by getting observers on board or using EM. In your opinion what do you think could be the main incentive to bring the artisanal fleets to the data collection world?
A: That's a very difficult question but it's critical. It depends on the technology; different technologies have different incentives including market incentives. The Smart Pass is designed as a system to really get a handle on the fishing effort and to mobilize really good techniques for stock assessments that have not been possible before, so the incentives are kind of indirect. There's the promise of better information on the stock status and the promise that with that, the stock will be around for your children and your children's children. That is a threat right now that if things keep going the way they have been over the last 30-50 years these stocks are going to be at risk. In my mind that's the incentive, but it's very difficult to convince people on the ground that that's the case.

Luis Cocas asking Hanz Jakob Olsen:
Q: Are you taking data on the other recreational fishers in you study besides the charter boats?
A: I didn't take that data on them on the onsite survey since that's covered by the offsite survey. We also have passive gear fishing like fyke nets, gillnets, spearfishing and land based and private boat fishing included as well. So, the offsite survey data is probably highly biased, it's more precise than the on site data because we had so many respondents in the offsite survey compared to the onsite survey. So it is a cost efficient way to get data, but if you want to use it for a stock assessment purpose then you need to have it verified by some other means.

Abstracts of poster presentations that did not provide Extended Abstracts

Mobile Electronic Recording and Reporting Application for Artisanal and Commercial Fishing Fleets

Amos Barkai

OLSPS, South Africa

Present small scales fisheries struggle with the need to record and report their catches and fishing activities in a simple, effective and affordable way. To tackle those difficulties, OLSPS has developed the Olrac Mobile Dynamic Data Logger (OlracMDDL). The OlracMDDL application is compatible with Android, iOS and Windows devices, and is fully customizable to any client specific needs, thus ensuring that both compliance and commercial reporting needs can be catered for. OlracMDDL can make use of the mobile device's GPS or of an external GPS so that vessel movements can be tracked at all times. Although initially developed with small scale fisheries in mind, OlracMDDL can also be used (and is already used) on large commercial fishing vessels. It is also fully compatible with the shore-system Olrac Dynamic Data Manager (OlracDDM), a webserver where data can be stored, analysed, and visualized.

Data entry in OlracMDDL is very simple and typo free, since all possible data can be entered using predefined lookup tables where known names, values and even images are stored and can simply be selected by the user. Examples are, name of fish caught, gear used, harbours landed, etc.… Lookup tables and other properties unique to each version of OlracMDDL are managed and automatically updated by the OlracDDM webserver, ensuring that lookup tables are always updated and uniform across the entire fleet.

OlracMDDL can make use of any communication network and devices accessible to the fisher. It includes Wi-Fi, Cellular network, and broad and narrow band (SBD) modems of all major service and communication technology providers. OlracMDDL also include a mapping component where vessel cruising and fishing activities can be marked and stored, a dedicated chatting utility, SOS messaging utility and other enhancements that make the OlracMDDL application a complete, reporting solution for small and large vessels alike.

Is the angler motivation for catch and release species or license –type specific?

Hans Jakob Olesen

DTU Aqua, Denmark

The potential impact of recreational fisheries is becoming increasingly important as society is focusing on ecological sustainability and animal welfare. Catch and release (C&R) is a common thing in many types of recreational fisheries and is important in terms of supporting a sustainable management of fish stocks. For many anglers the opportunity of releasing a nice meal is not up for discussion, whereas others would not dream of killing the catch. In some fisheries, the C&R is thought to be of minor importance where other species are almost exclusively C&R. We study two very common species caught in the recreational fisheries in Denmark; sea trout (*Salmo trutta*) and Atlantic cod (*Gadus morhua*) and test for different motivations for C&R and if these potential differences are linked to the type of license purchased.

The importance of recreational catches in a decreasing Atlantic cod stock

Hans Jakob Olesen

DTU Aqua, Denmark

Monitoring of marine recreational fisheries has become increasingly important for several stocks as both scientists and fisheries managers have recognized that the potential impact of recreational fishery on a stock can be significant. However, fisheries managers often lack information on the recreational fishery, as reporting of catches in most countries is not mandatory as for commercial fisheries. This lack of information on recreational catches can become critical e.g., when a decreasing fish stock is targeted by both recreational and commercial fishery and the stock assessment only includes data from the commercial fishery.

The western Baltic cod stock has been decreasing since the late 1990'es and is targeted by both commercial and recreational fisheries. The recreational part of the total annual catch has increased from 10-15% to more than 30% during the last years and being a record high in 2021 with 46%.

The recreational catches of western Baltic cod has been monitored in Denmark since 2009 using an off-site interview/questionnaire based recall survey. This type of data collection relying on fishermen and anglers voluntarily reporting their catches is typical for artisanal and recreational fisheries where official landing data is often scarce or unavailable. However, the reported catches are believed to have multiple biases e.g. recall bias, avidity bias, telescoping resulting in an overestimation of the total recreational catches. We therefore included a probability proportion to size based on-site survey targeting anglers on board charter boats to allow for collecting biological samples and tuning of the off-site recreational cod catch time series back to 2009. The on-site survey results showed lower mean catch rates per angler than the off-site survey. The tuned time series combined with biological sampling allowed for inclusion of the Danish recreational western Baltic cod catch estimates in the stock assessment for Western Baltic cod.

Session 12. Covid impacts on monitoring programmes, strategies employed, lessons learned and best practice recommendations

Leader: Kenneth Keane

Impacts of the COVID 19 pandemic on observer programmes have been widespread and significant in nature. Observer programmes were forced to alter their practices to address the challenges of deploying observers on to fishing vessels, and develop inventive ways to train groups of observers during a health emergency that sought to isolate and/or distance individuals for health and safety reasons. This session detailed the strategies used in various observer programmes to adapt to COVID-19 impacts and documented both lessons learned and best practice recommendations for the future.

Oral Presentations - Extended Abstracts

From the Screen to the Field: How the North Pacific Observer Program adapted observer training during the Covid-19 pandemic.

Adriana Myers

NOAA Fisheries, Alaska Fisheries Science Center, Fisheries Monitoring and Analysis Division, North Pacific Observer Program

On March 11th of 2020, the World Health Organization declared a global health emergency due to the Covid-19 outbreak. The NOAA Fisheries issued evacuation orders and on March 23rd, the Alaska Fisheries Science Center (AFSC) issued mandatory telework orders, resulting in the suspension of observer training activities. In Alaska, commercial fishing vessels are mandated under Federal regulations to carry for observer coverage and therefore it was critical to maintain continuity in observer training; it was imperative to support fishing operations and Alaskan communities.

The North Pacific Observer Program training team recognized the urgency to resume mission-critical training sessions, which had historically all been held in-person. While everyone transitioned to telework, in just a few weeks, the training team re-engineered the training and briefing methods to utilize remote technologies. Although all training and briefing types were adapted, the 3-week Initial Observer Job Training (3-week class) for new observers was the most complicated. Because of the reliance on hands- on exercises, taxonomic laboratories, and Cold-Water Safety instruction, this 3-week training class was considered unsuitable for remote settings. However, even presented with these obstacles, the training team was determined to overcome the challenges and continue training new observers. The team started working tirelessly to restructure the training curricula, focusing on four major components: safety, species identification lectures and labs, hands-on sampling activities, and testing.

In order to prioritize safety and ensure that an adequate number of newly certified observers were available to deploy in support of the Alaskan fishing industry, a training plan was developed for the 3-Week class that included two weeks of remote sessions followed by a week of on-site training. Since our program was deemed mission critical, it was approved to conduct a limited number of in-person operations, allowing for curricula development. The existing curricula were adapted and new content created to be used in a virtual setting. The emphasis was on the use of an integrative approach to incorporate technology as a teaching tool. To ensure the trainees had access to all the training supplies during the remote component, materials were carefully packed and mailed to each individual, one week prior to the start of class. Over 450 boxes, weighing 16 kg each, were mailed during the pandemic years, reaching almost every state in the country as well as some international shipments. The boxes included an immersion suit, the Observer Sampling Manual and Observer Logbook, class handouts, sampling activity packets and kits, safety information, a calculator, and writing tools. While preparing these boxes required extensive effort on the trainer's part, it provided the materials essential to setting the trainees up for success.

The remote component of the 3-Week Initial Observer Job Training was structured as follows:

- 10 days averaging 9 hours of screen time per day
- Daily Immersion Suit Drills
- PowerPoint Presentations
- In-Class Exercises
- Asynchronous learning
- 2-4 hours of homework after class each day
- Additional homework and exams completed using the online Observer Training System (OTS)

A key component of the success of re-engineering the training curricula was the development and implementation of a web-based application, the Observer Training System (OTS). The trainees used the OTS to complete sampling exercises, quizzes, and chapter-focused final exams. This system also allowed the trainees to access and review training material.

After developing strict COVID-19 safety protocols to promote the health and safety of all participants, curricula that required in-person instruction were identified. On-site training included timed structured activity stations, accommodating small groups of five or less people.

These stations included:

- Cold-Water Survival Training
- Species identification labs
- Hands-on sampling activities that were transferable to the field.
- Safety and hands-on sampling activities exams using the OTS
- Hand-on Species ID Exams



The transition to a hybrid training environment was exceptionally challenging. The mental and physical demands associated with the intense nature of two weeks of remote training were considered. The team worked unremittingly to provide trainees access to all the tools and resources necessary to become successful in the field; especially important considering the limited time allocated for in-person activities. We were forced to think outside the box in order to develop a strong curriculum that would support the health and safety of all participants.

As we transition back to full in-person operations, the training strategies our program developed during the pandemic years continue to positively affect our growth and modernization of our year-round mission-critical training. There were many lessons learned and we will be adopting much of the new material and training protocols as regular components of our training curriculum, including but not limited to:

- Structured Species ID Training modules that provide trainees with an efficient and very effective learning opportunity.
- The Observer Training System (OTS)
- Improved and more engaging presentations
- Asynchronous learning

The resilience of our observer workforce, observer providers, and program staff played a key role in the successful adaptation of our year-round mission-critical training.

Thank you to all the observers for their continued dedication especially during the unprecedented pandemic years. Your resilience has been inspiring!

How the North Pacific Observer Program is overcoming a world under pandemic: a history of resilience and adaptability in extraordinary times

Raul Ramirez

Fisheries Monitoring and Analysis, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, USA

There is no doubt that the COVID pandemic has dramatically affected how the North Pacific Observer Program functions at every level. Training, briefings, annual briefings, and debriefings have been conducted mainly in a virtual environment, and the FMA division has evolved our testing platforms for observers to obtain the same quality training.

The Observer Program provides the regulatory framework for NOAA Fisheries certified observers to collect data on groundfish and halibut fisheries. The information collected by observers provides the best scientific information to manage the fisheries and to develop measures to minimize bycatch. Fisheries observers are biologists who work independently to collect a wide range of information onboard commercial fishing vessels and at shoreside processing plants receiving fish from Alaskan waters.

As a result of pandemic-related restrictions on travel, office staffing levels, and in-person meetings, the majority of the NPOP's activities to support observers in the field were shifted to operate remotely. We continued to hold all briefings and specialized training virtually and limited in-person interactions during the three-week training. Only hands-on safety and Fish and Crab identification training were conducted in person. Situational telework maximized to prioritize onsite mission-essential/mission-critical operations, maximizing situational telework to 5 days per week.

On the field, observers were quarantined 14 days prior to embarking on vessels or accessing plants. Also were subjected to multiple and frequent COVID tests, remained confined to work sites without the possibility of meeting other coworkers, and were required to use masks in the working areas. Field offices were closed and the supply of sampling gear was severely limited. Any inquiries were answered only by phone.

To deal with all these unprecedented new challenges, safety health measures were put in place to protect us from infection and keep working efficiently. Almost all the training and debriefing activities were transferred to remote platforms. Only data pick-up and safety training was performed keeping social distancing. Observers checks were performed following a rigorous protocol. Vessel sampling stations were performed inside the factories using masks and keeping social distancing. The entire staff went through a mandatory virtual covid safety orientation. A robust contact tracing system was put in place, so workers were notified immediately if they were potentially exposed to the virus at a worksite.

Is important to highlight that moving to remote platforms was a huge change in our daily working routine that allowed us to transition from working in person to a virtual working environment without a major effect on the observer training and debriefing process.

To facilitate our field operations and safeguard the safety and health of the observer several measures were taken. Observers' contracts were extended up to 120 days for eligible observers to help to reduce office interactions while also minimizing the need to swap out observers, access to the office was granted by previous appointment, and sampling gear was issued a pre-packs sets and NMFS field staff delivered gear and relevant information directly to worksite. It required an ample level of coordination with the observers' providers.

All these measures allow us to continue our mission during 2020. Then in April 2021, we had a huge breakthrough when the U.S. government opened vaccine eligibility to residents aged 16 and over. On campus, vaccination was encouraged for NOAA staff and mandatory for observers, and 25% occupancy was allowed. On the field, observers are allowed to walk out of work sites/meet coworkers, and access to the processing plants was granted

One year later, we reached, for the first time, a low COVID-19 level of risk (meaning that masks and social distancing were not required) and we received a 30-day notice to return to the office. New spaces were facilitated, limiting 2 people as the maximum occupancy by the office.

Currently, campus and field office operations returned to normal always following the NOAA COVID-19 community-level risk mandates, and training and debriefing returned to live and in-person, but masks must be used for observers and staff inside the buildings at all times. More importantly, we develop the potential to come back anytime to maximum telework because all the protocols are already well established.

Unquestionably, the COVID pandemic turned our lives upside down. It brought many challenges at the personal and professional levels, lives were lost, and mental health was severely affected. COVID was a test of our resilience and adaptability, we grew stronger as a team and lessons were learned: hybrid onsite/home office schedules are possible, observers proved once again to be a committed, strong, and resilient workforce and we were able to significantly streamline processes improving production.

In spite of those challenges, the Observer Program was able to monitor, with either observers or Electronic Monitoring, 43% of fishing trips for all the federal fisheries off Alaska, supporting the fishing communities and the U.S. economy. Just in 2021, 378 observers were trained, briefed, and equipped for collecting data onboard 296 fixed gear and trawl vessels and at 12 processing facilities for 35,769 observer days.

The Fisheries Monitoring and Analysis Division strategy allowed for the continuity of observer deployments and safeguarding of those deploying to Alaska fishing communities staying fully operational throughout the worst parts of the pandemic.

Data Quality in the Time of Covid-19

Christa Colway

NOAA Fisheries, Northwest Fisheries Science Center, West Coast Groundfish Observer Program

Introduction

Much discussion will inevitably be centered around the global pandemic, a historic event which has greatly disrupted modern life for everyone on the planet. This has caused widespread mental health problems such as stress and anxiety (Salari et al., 2020). Other studies Hamid et al. (2020) and Popa et al. (2022) have shown employees are stressed due to a fear of catching the corona virus which affects their performance and productivity. In office settings, social distancing and mask wearing may help mitigate these fears, however, fisheries observers live and work in environments where those mitigation measures are impossible to maintain.

The WCGOP continued to deploy observers with limited interruption throughout the pandemic. During this time there was a measurable decline in data quality. I hypothesize this was caused by programmatic changes and the stress on observers due to the pandemic. Analyzing the amount of failed hauls, data which could not be used, between 2012 and 2022 showed an increase which correlates to the pandemic. We will continue to monitor failure rates to see if it starts to decline now that our operations have returned to pre-pandemic routines.

Methodology

It’s difficult to find a metric to assess data quality. However, the WCGOP has a “fail” database flag that can be assigned to a haul. The fail flag excludes the data from being used by fisheries managers and researchers. A haul is marked with this flag if it does not pass our quality controls. Reasons for failing a haul include lost raw data, missing critical information, sampling which didn’t follow standard methods potentially introducing bias, and data integrity concerns.

Failed data doesn’t flag all problems. Depending on the situation we may have the option to delete an observer’s sample data and extrapolate the discard for a given haul without failing it. This is still a data loss because we’re losing the resolution of the observer’s sample but it would not be marked as failed.

All non-midwater data from 2012 to 2022 was pulled for analysis. Midwater fisheries were excluded because they are full retention and over this time period transitioned from human observer to mostly electronic monitoring. At the time of analysis 2022 data was not entirely finalized and the number of failed hauls may increase but will not decrease.

Results and Discussion

Looking at the percent of observed hauls failed, the overall average from 2012 to 2022 is 0.5%; however, there is a noticeable upward trend in the last few years (Figure 1). Years 2012 and 2013 barely register with a failure rate at 0.12%. Between 2014 and 2018 the percent of failed hauls fluctuates but is an average of 0.25%. In 2019 the failure percentage rises to 0.59% and it continues to climb each year culminating in 2022 at 2.34%.

In March of 2020 Covid-19 started affecting our operations. Federal buildings closed and mandatory telework began before the end of our second observer training causing us to finish remotely. This was the beginning of how we had to rethink how to train, deploy, and debrief observers. Training was reconstructed to a hybrid of remote for two weeks, with one week in person for fish identification and safety skills. Briefings were virtually conducted for two years. Similarly, debriefings became virtual for over a year until in person meetings could be selectively held.

While we maintained covering boats throughout the pandemic, our deployment model changed so that observers would be assigned to one vessel and have a two week quarantine prior to changing assignments. In 2020 we also began seeing lower observer retention. More observers were trained in 2020 than in the past seven years. Retention was average for 2021 but decreased again in 2022 leading to training more observers than in the past ten years.

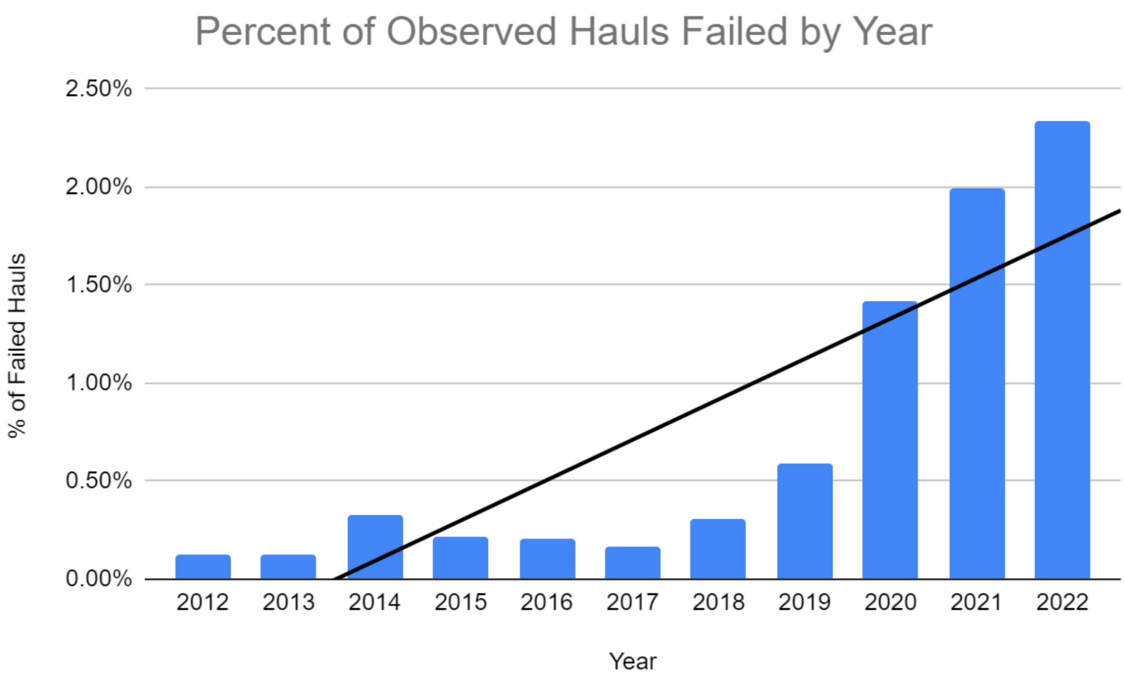

Figure 5

Just knowing the failure rate is increasing doesn't provide much information. A closer look at where the failures are occurring by gear type is in Figure 2. There was a large spike in number of bottom trawl hauls failed in 2021. Of the 146 trawl hauls failed, 77 are attributed to one observer which is an unusually high number as problems are normally discovered and corrected before large amounts of data are collected. However, there is still a spike of failed hauls even if that one individual is removed from the analysis. The bottom trawl failure rate decreased in 2022 but peaked for shrimp trawl, longline fixed hook, and pot gear. There is no one gear type that stands out as possibly needing more focus in training.

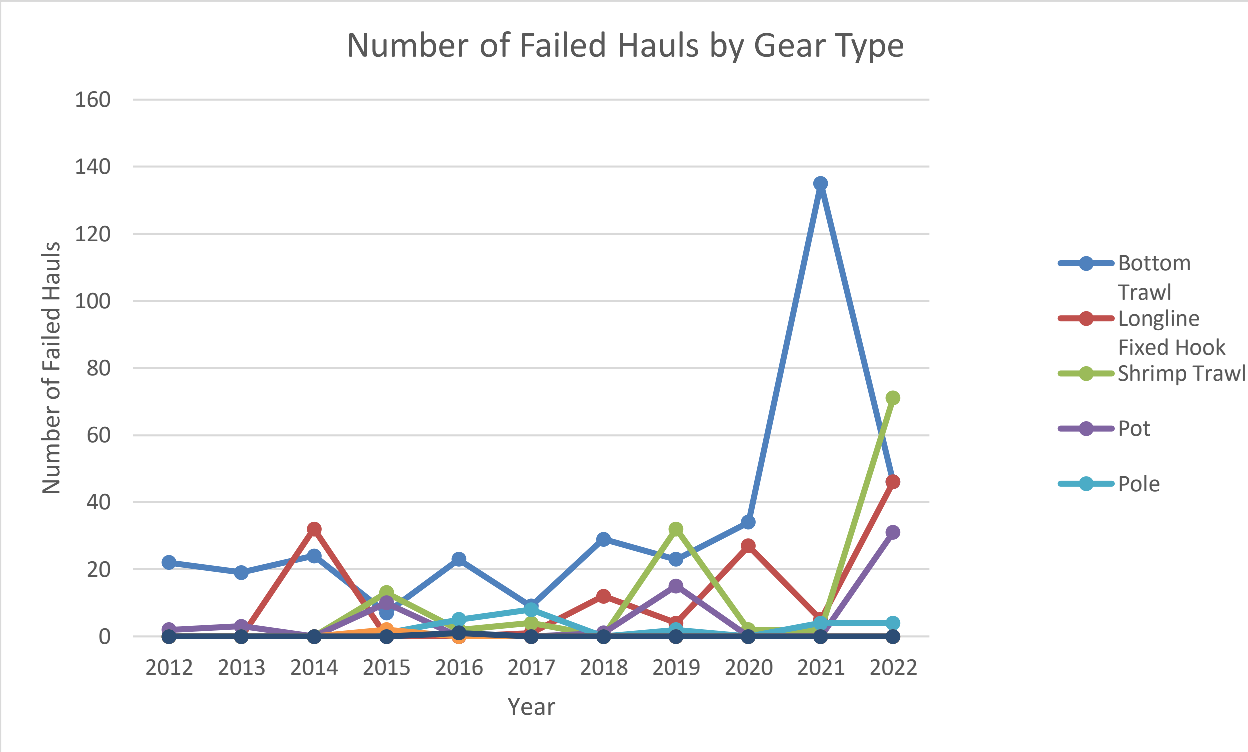

Figure 6

Summary

While the percent of failed hauls is increasing it's important to maintain perspective as the failure rate is under 2.5%. However, we should still strive to reverse the trend. If the changes to training, briefing, and debriefing had an effect, it will be interesting to see if it reverses now that we've returned to in person instruction in 2023. We'll continue to monitor the failure rates and add more tools to capture additional metrics to assess data quality, such as a tracking deleted data.

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Abstracts of oral presentations that did not provide Extended Abstracts

Cooperative Recovery of Pacific Islands' Observer Programmes

Timothy Park

Pacific Community, New Caledonia

Observers in the Western and Central Pacific Ocean (WCPO) have the dual role of collecting scientific and compliance data and information. Since 2018, a FAD closure period and a catch retention measure require 100% observer coverage on purse seine vessels in the WCPO. This required a dramatically increased number of observers among the 14 national observer programmes of the Pacific Island Countries (PICs). By 2012 there were over 800 observers active in the WCPO tuna fleets, most were casually employed.

On 27 March 2020, the COVID-19 pandemic led to observer coverage requirements being suspended, essentially ceasing observer placements in the region. This initial 3-month suspension has now been extended until 1 January 2022.

However, the repatriation of observers from remote ports was complicated by travel restrictions, and PICs sealed borders. Many observers remained expatriated for up to 18 months or remained on the vessel until they could return home.

The cessation of placements and protracted repatriation of observers meant that the coverage levels of 100% pre-pandemic, dropped to 43% in 2020, 13% in 2021 and just 4% of the known trips so far in 2022.

Implications of the 33-month suspension of observer monitoring in the world's largest tuna fishery led to national concerns about IUU fishing, and regional stock assessments are being impacted especially in the estimated catch of bycatch species. It also impacted observer livelihoods, leading to observer attrition, over 1/3 of skilled observers have left for alternative employment, often abroad.

Now observer programmes are now rebuilding their capacity, through refresher training and training of new observers. National programmes generally rely on regional agency support for capacity development and support, though they in turn have limited capacity and funding available.

Open Discussion Session

Carolina Breakell to panel
Q: How did observers and observer programs who experienced COVID, cope with the lack of employment or potential for a heightened health risk? How was COVID tracked among observers and programs?
A: Tim Park: In the Pacific Islands, a few of the observers in certain programs were able to find other employment, such as getting them involved with other sorts of dockside sampling. However, a lot of products for the government and other agencies were shut down completely. A lot of their observers went back to their home communities and main cities. In the broader sense, COVID took a large toll on the Pacific Island observer and fishing communities due to less developed safety measures in place.
Adriana Myers: In Alaska, other than a brief two-week pause, observer work was relatively continuous through the pandemic. A hybrid training format made this more feasible, to alleviate the stressors of many program affiliates having limited to no office access and observers having less freedom of travel.
Ken Keene: Observer deployment varied across the United States, for example being on a 30-day trip implied less exposure to COVID than programs of shorter and more spontaneous trips. Unfortunately, with the nature of COVID, it’s essentially impossible to track among observers, such as whether they got it from home, the vessel, or in transit on a trip.

James Moir Clark to panel
Q:. How did observers and their programs deal with observers coming across COVID-infected persons on deployment?
A: Adriana Myers: From the training perspective, observers were kept healthy due to strict COVID protocols, both between the government and the providers that employ observers. Virtual training was used for many protocol and introductory concepts, whereas regulated in-person training was used for safety and more hands-on job duties. Observers were always tested for COVID before in-person training activities, and their temperatures were checked regularly throughout the process. Sometimes, but not always, fishers were helpful in minimizing COVID on their vessels, such as ensuring no one was sick before sail, or sometimes by wearing masks during fishing effort. There were also quarantine timeframes for observers in travel status. Recognizing there were different company standards and smaller vessels, etc., required acknowledgement for nuanced protocol scenarios. Not every observer experienced with mitigating COVID or contracting COVID was entirely the same.
Gwynne Schnaittacher: There is a working group from when Ebola was an issue that includes representatives Discovery Health, industry, Washington State, Alaska State, and NOAA. This group was regularly meeting.

Phil Bear to panel
Q: During the COVID pandemic, were the standards for observers very different from the industry standards?
A: Adriana Myers: This was one of the main frustrations of observer programs in the pandemic. Many captains in the Southeast United States had the mentality of COVID being a government conspiracy, and so it’s nearly impossible to ask them to be COVID compliant in any way. During the COVID pandemic, were the standards for observers very different from the industry standards?

Jorgen Dalskov: EU boats were extremely safety focused, pushing for safety precautions.
Christa Colway Unfortunately, this made it hard to make efficient data collection for observes in the southeast (as well as other parts of the United States) during COVID.
Tim Park: In Pacific communities, observers were sometimes seen as “spreaders” by fishers due to their traveling nature, and so fishers were less likely to accept an observer out of fear. This was often alleviated once those Pacific communities started getting COVID.

Cheng Shi to Adriana Myers
Q: In the 90 screen hours you used to train observers virtually during COVID, was your 2-3 hours of homework included in that 90-hour accumulation?
A: The homework was not included in the 90 hours of virtual instruction. Training classes were 0800 to 1700 with (aside from breaks) consistent screen time for 8 hours. The assignments were done between training sessions by the observers, but they had virtual (or cellular) access to trainers if they had any questions since the observers didn’t have the resources or access for the observers to work together like they typically did in full in-person training pre-COVID.

Cheng Shi to panel
Q: With some of your [all the panelists] programs sticking to a hybrid [in-person and virtual] training, what were some of the considerations to keep those training tactics.
A: Adriana Myers: Some programs (particularly in the United States) have gone back to full in-person for the initial three-week training and annual briefings, with many programs believing the training should be as in-person as possible since some skills (biological sampling, safety) can not be properly taught virtually. However, depending on the state of the trainers and prospective observers, masks and other COVID protocols can be incorporated at any time in future pandemic scenarios.
Christa Colway: West Coast USA is now doing fully in person trainings.
Raul Ramirez: Alaska program has gone back to in person debriefings with PPE in the last month.

Debra Duarte to Adriana Myers
Q: In the North Pacific Observer Program, what does asynchronous learning look like? What are some examples?
A: In this program, it was decided that not all curriculum for observer training needs to be instructor-led, such as safety videos being assigned to trainees to watch before in-person training sessions. Also, with some other conceptual videos, a question set of “homework” will be assigned to ensure the trainee observers understand the core concepts, and they can still ask any questions they’d have when the next training session begins the following day. This allowed more time for more hands-on skills activities, while also reducing screen time necessary to complete training.

Debra Duarte to panel
Q: With there being a loss of data quality from observers due to changes caused by COVID protocols, has there also been a loss of data quality from the debriefer side as well?
A: Christa Colway: This is definitely possible, and can be more fully pursued in the future with debrief auditing, but limited funding and other resources make this a challenge. There’s also the process of looking at debriefer information as observers in a matrix to identify and measures data biases, which some observer programs have adopted.

Tim Park: Pacific Islands tracks quality with a series of metrics.

Karl Staisch to panel
Q: When online training was incorporated, was it shorter or longer in time in comparison to in-person training?
A: Adriana Myers: In the beginning of March 2020 when the pandemic was hitting the United States and virtual training had to be incorporated over a very short time period, it was definitely difficult to manage a reasonable timeframe. This was a huge adjustment period for both trainers and trainees. With virtual training, it was necessary to take more breaks (no more than 90-minute blocks of continuous training) to limit fatigue, since this was shown to be more prevalent when staring at a screen as opposed to in-person training. As a result, training sessions had to be restructured to this model. Technical difficulties of virtual training always added extra time to the day, especially in the beginning of the pandemic, and this added complexity to the training periods.
Tim Park: COVID outbreaks in Pacific Islands caused training to be delayed because of the strict closures of ports. It took 2.5 years to go home and he had to do a 21 day quarantine. Many people were stuck in whatever country they were in when the shutdown occurred.

Shane White to Christa Colway:
Q: Has the pandemic caused any sort of push to pursue Electronic Monitoring (EM) into observer programs?
A: There a lot of legal and regulatory challenges to adding Electronic Monitoring equipment to a vessel, and this has been a large obstacle for the last ten-plus years. EM-implementation is definitely worth considering in future pandemic scenarios, but it was still in its early days at the beginning of the COVID pandemic. In some governments, EM was completely shut down in parallel with other governmental products and services, but one may expect this to be more readily deployable in future pandemics.

Cameron Desfosses to panel
Q: Did you notice an increase in observer test failures in training because of a lot of the training being partly online?
A: Adriana Myers: In some programs, there has been an increase in failures over the past couple years, compared to pre-COVID years. However, this may not be directly caused by the training, but also by changes in the candidate pool, as well as challenges in trainers being aware of the level of knowledge trainees possessed before training began. Furthermore, both training success and observer information retention have been challenged during the remote components of training. It’s also hard to have certainty that it was the fact of remote trainings that lead to the failures or observers who left after one contract.
Christa Colway: There are too many variables to take into account to say totally for sure, but more people were failing in remote trainings. Its harder to read the room (in remote trainings), and gauge comprehension.
Raul Ramirez: Debriefers in the Alaska program were giving out more 0s (datasets are pass/fail with a 1 for pass 0 for not pass).
Tim Park: When they start getting the post COVID closure datasets they will be able to use debriefings to gauge if data quality has been affected.

Sifa Fukofuka: In the South Pacific, they used a lot of theory in remote trainings, did ID on zoom, so there was an intention when countries opened up that they would be able to catch up on the more hands on and practical aspects of training.

Joshua Lee to panel
Q: From a debriefing perspective, what is or is not quality data, and how is this metric standardized and decided among observer programs?
A: Christa Colway: It is a scale, there are degrees of quality, data issues are discussed with office. There is potential to use a decision tree or flow chart for observers to avoid common mistakes. They can also use some electronic checks rather than hand checking all data. There is a potential for AI applications to speed up the process. Even when data is failed data, it can be considered and compared in future data audits and debriefings. With every failed data, there's discussion to improve or mitigate these. In conclusion, quality data is a moving bar and is nuanced with the type of data, the science backing it, and the biases that can be eliminated. There is no straight-forward standardization.
Tim Park: EM and debriefing verification, you can use EM to cross reference and validate. Currently 20% of EM data is viewed. Just because you can see the data on the tablet doesn't mean you can't find out more by sitting down and asking the questions in person.

Macdara O'Cuaig to Adriana Myers
Q: In Ireland we suspended having observers at sea for the COVID shutdown and instead taught the fishermen to self sample. We trained fishers remotely using the phone, they had very specific instructions and questions on the data sheets given to them, and they used WhatsApp for mid-trip check-ins. The industry liked this. They could cross validate 1 haul per day for industry samples which is far fewer than you'd get with an observer but better than nothing. It also gave industry a better understanding of the process and the work that the observers do. They can see in real time gear mitigation measures changing catch composition. As part of the self-sampling the fishers did bring boxes of fish in for the scientists on land to check ID and take biological samples. In the United States, has there been ay consideration to ask fishers to collect observer data to fill the data gap that would happen in a pandemic (like what Ireland did)?
A: No. Despite this success in Ireland, this has not been properly considered in the United States. There are already plenty of compliance issues and coverage challenges in the United States, and so to incorporate a program for fishers to do observer work (even limited), would be a very difficult and lengthy process, if successful at all. This kind of process is expected to be very industry-dependent and have a broad disparity of success between countries and governing bodies.

Training observer online during covid.

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Muséum national d'Histoire naturelle (MNHN), Laboratoire de Biologie des Organismes et Ecosystèmes Aquatiques (UMR 8067 BOREA), France

Introduction

While observers could still be deployed on vessel operating in the French EEZ of Kerguelen and Crozet, maintaining a 100% observer coverage, the issue of training new observers at distance came up during COVID lockdown as a challenge for the National Museum of Natural History in charge of the scientific observer program.

Solutions developed

Computer equipped of a webcam were posted to the observers at their home address for data entry exercises with the fishery logbook and also to interact with them.

Online documents were produced with the list of tasks to be completed. Observer noted the steps taken as they occurred and the coordinator could follow the progress of their work online in real time for each of them.

The quality of the internet connection being unknown before the training, many videos tutorial were made to show all the steps of data entry and verification, thus, the observer could watch those videos as many times as necessary to achieve the exercises (figure 1).

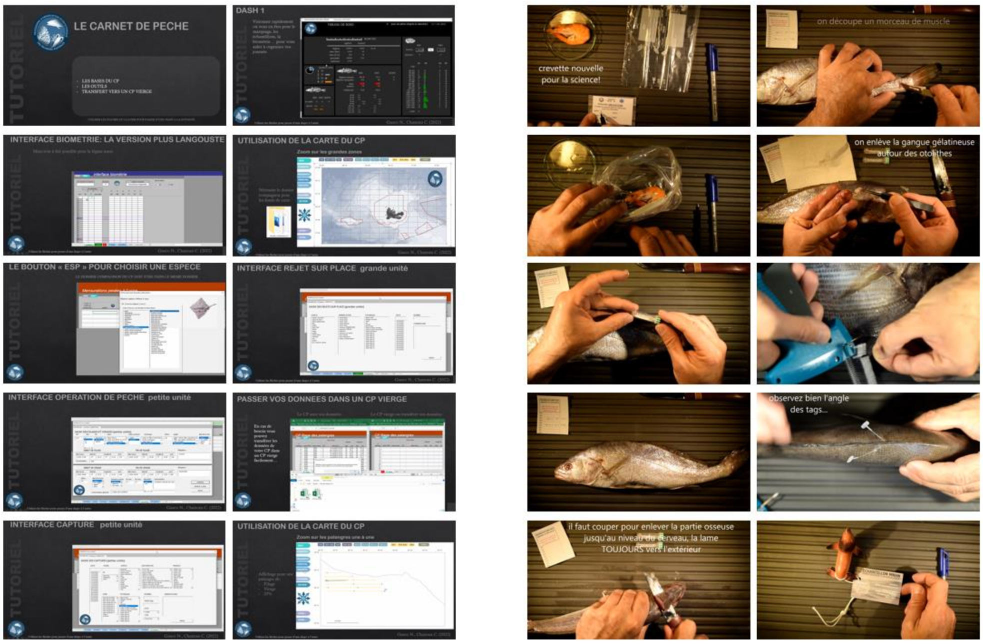

Figure 1. Screen captures of video tutorials showing all the tools and logbook data entries (left panel) and videos of all the biological measurements and samplings (right panel)

Tutorial videos of all the sampling and measuring methods were also produced and gear (forceps, scisors, labels, bags, tubes etc) was posted to the observer's home address before the training session. They were able to obtain a fish at the fish market to complete the session and each observer performed the tasks in front of its webcam (figure 2).

Figure 2. Parcel with the gear necessary to complete the training (left) and screen captures of candidates performing the biological measurement and samplings at distance (right).

Data entry and final evaluation were sent by email for verification to the technical coordinator.

<u>Conclusion</u>
Even if the conditions were obviously not ideal yet we managed to train several observers at distance and achieved to maintain a 100% observer coverage. The use of all the tutorial videos was a success More videos were developed since, they represent very useful resources used during training and for observers at sea.

Workshop 1 – Observer Safety

Leader: John La Fargue (NOAA, USA)

Introduction

Recognizing observer safety is paramount to deployment of observers globally, safety workshops have a long history at the IFOMC. This tradition continued at the 10th IFOMC. In 2004, there was a focus on "Professional communication and conflict resolution training for observers" (McVea and Kennelly, 2005). Safety-specific workshops were also held in 2007 and 2009 (McVea and Kennelly, 2007, Nardi et al., 2010). At the 2016 IFOMC in San Diego, safety was included as part of the Observer Professionalism Workshop (Kennelly, 2016). This workshop incorporated the opportunity for discussions on safety, but also hands-on training with the Damage Control Unit and simulated fire training were offered outside the workshop. In 2018, at the IFOMC in Vigo, a small group breakout session format was used to discuss major safety concerns among programs (Kennelly and Borges, 2018). The success of the interactive breakout session format supported the decision to revisit the 2018 topics at the 2023 IFOMC. This allowed for follow up on past topics, recognizing where progress has been made, and to ascertain if new issues have emerged. Additionally, having gone through a worldwide pandemic, it was important to reflect upon that impact on observer safety, not only reviewing lessons learned, but how best to move forward and continue to promote observer safety worldwide.

2023 Safety Workshop Goals/Format

The goals of the 2023 safety workshop were to:

1. Identify major safety concerns among observer programs and areas of improvement

2. Identify best practices

3. Raise awareness

The Safety Workshop participants were composed of observers, observer program managers and staff, electronic monitoring staff, and non-governmental organizations. The participants were split into three concurrent 45-minute break-out groups to share experiences, concerns, and best practices from their programs. Observers were split into a separate group so that they could speak freely without program staff present. The final 45-minutes included a brief overview by a representative of each group on the most important points discussed in their group.

Many of the issues that came up in the groups were common among observer programs. However, there were a few concerns that stood out. Most attendees agreed that harassment, vessel safety, and mental health were the top three major areas of concern. These three topics were also identified as the major concerns at Vigo IFOMC (2018), but it does appear that this year, the discussion around mental health was more elevated than in past years.

Harassment

Many participants felt that harassment was under reported. It was brought up multiple times that harassment is not limited to crew and observers but also includes harassment between observers & staff, and between observers.

Major concerns**:**

- SASH (Sexual assault sexual harassment)
- Hostile work environment
- Lack of follow up by programs and enforcement
- Lack of knowledge about available resources.

Best Practices

- Utilizing Satellite communication for reporting incidents
- Satlink was brought up as an improvement over the more basic services providing only text capabilities.
- Increase industry engagement - Industry involvement with anti-harassment policies and contracts.
- Developing strong relationships with enforcement agencies, including improving the feedback loop from enforcement to observers and observer programs.
- The utilization of vessel surveys and logbooks to document information, situations, etc.
- More quality training on defining, dealing with, and reporting harassment for both observers and staff.

Vessel Safety

Three main areas were identified for vessel safety: vessel conditions, operational safety, and personal safety.

Major concerns

Vessel Conditions

- Safety equipment condition or deficiencies, modernized.
- Nutrition
- Cultural/language barriers
- Bed bugs
- Operational Safety Concerns
- Lack of or improper wheel watch
- Substance abuse by crew

Personal Safety

- Sleep deprivation
- POB(person overboard)
- Ergonomics
- Deck Safety Awareness

Best Practices:

- Inspections by agency/organization responsible for marine safety
- Multiyear safety certificates
- The right for observers to refuse trips on vessels they feel are unsafe.
- Issue proper/modern equipment for safety and sampling.
- Proper training on how to use equipment.
- Training needs to be fluid and adjusted to current times and situations.
- Increase communication with the industry/vessel operators about unsafe/unacceptable vessel conditions.
- Improve communication between observers and providers/programs about vessel conditions, crew behavior, food, etc…
- Develop and update clear and defined EAPs(Emergency Action Plans)
- Make safety resources available to observers and staff.
- Utilize pre-deployment safety/operational checks
- Utilize post cruise assessment/survey
- Provide safety training to crews- in appropriate language.
- Only deploying observers under safe conditions and on safe vessels.

Mental Health

Mental health was a dominating theme throughout the conference. There was support for more discussion and training on this topic at future conferences as well as considerable for a stand alone session solely on mental well being

Major concerns

- Poor work/Life balance
- Lack of training on mental preparedness
- Lack of or not enough paid days off or lack of flexible schedule to deal with medical, family, etc…
- Substance abuse by observers

Best Practices:

- Allowing observers to have hauls/fishing activity off through a random table.
- Allowing observers to skip hauls/fishing activity at their discretion.
- Set a maximum number of hours worked in a day.
- Provide guaranteed, flexible time off to deal with medical and family needs.
- Increase communication between observer providers, programs, and observers.
- Increase observer engagement with program/management/industry meetings.
- Provide observers with resources for substance abuse and mental health.
- Normalizing mental health discussion
- Fostering community-Master class, contact list, mentoring, communication planning, training

Closing remarks

The IFOMC is grateful for the candid input from the safety workshop participants and encourages programs to integrate applicable best practices into their programs. It is also encouraged to keep dialoguing about these topics not only within your program, but with other programs. There is so much collective experience and information out there. You are not alone in dealing with these issues.

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Workshop 2 - Electronic Monitoring

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Background and Workshop Goals

It has been over two decades since the first EM systems were deployed on fishing vessels and there are now several thousand systems installed around the globe. Interest in deploying EM where its efficacy, operational feasibility, and cost effectiveness can be demonstrated continues to grow, but there is significant operational complexity and stakeholder dependencies that must be addressed for successful EM implementation. With a growing number of EM pilots and programs there is increasing understanding of some of the challenges and opportunities associated with integrating EM with other tools in a comprehensive monitoring program.

The EM Workshop brought together experts from a diverse group of stakeholders to discuss emerging themes at the intersection of EM and other monitoring tools, with a focus on at-sea observer programs (ASOP). The overarching goal of the workshop was to engage the fisheries monitoring community and develop a shared understanding across three emerging themes (described below) and develop a workshop summary of challenges, opportunities, and outstanding questions about the integration of EM with other monitoring approaches for wider stakeholder consideration.

Workshop Summary

1. Plenary Presentations and Q&A

The workshop commenced with plenary presentations by Joel Kraski (NOAA) and Andrew Fedoruk (Archipelago Marine Research Asia) that provided real-world examples and experience of integrating electronic monitoring with other monitoring tools and approaches. These presentations highlighted how integrating EM with other monitoring tools can efficiently improve coverage and data quality, and focus human observers on high-skilled tasks (e.g., biological sampling). Extended abstracts of these presentations can be found at the end of this workshop summary.

Following the presentations, the speakers participated in a 45-minute Q&A session. Questions from the audience ranged across a variety of topics and included how to incentivize the use of EM; the pros and cons of mandating the use of EM on vessels that avoid ASOP coverage; the pros and cons of EM programs with single or multiple vendors, promoting equipment interoperability to the extent possible, and the use of minimum technology standards and/or EM provider approval; and incorporating science into EM data collection requirements.

2. Small Group Breakout Sessions

Following the plenary sessions, workshop participants distributed themselves into breakout groups. The purpose of these breakout sessions was to have small-group and direct conversations and to identify key challenges, opportunities and questions across each of the three workshop themes. Post-it notes were provided to allow participants to document and share the key takeaways from their discussions. The following is a summary of the most commonly identified Challenges, Opportunities, and Questions submitted by breakout groups across the three workshop themes:

Theme 1. Operations, deployment, and logistics of EM versus ASOP - Under this theme, participants discussed the tradeoffs between operations, deployment, and logistics when implementing EM and ASOP.

Discussion in many of the breakouts centered on costs as an ongoing challenge for electronic monitoring programs. Although we've seen significant efforts and progress developing EM in the last many years, participants cited a lack of understanding regarding the "true costs'' of an electronic monitoring program and concern over "hidden" fees or unaccounted for expenses (e.g., power requirements on small vessels). Workshop participants also highlighted the continuing rapid evolution of technology as an opportunity. Technological advancements (e.g., Starlink, wireless transmission, etc.) are creating new opportunities globally to remotely monitor fishing vessels that were previously difficult to monitor either via EM or ASOP (e.g., long trips far from shore).

Theme 2. Employment implications of EM versus ASOP - This theme considered the key employment drivers and tradeoffs emerging with the inclusion of EM into fishery monitoring programs.

Because EM is still a relatively new tool in most regions, participants agreed there are opportunities that have not been fully explored. Participants discussed the potential to mitigate ASOP burnout and/or facilitate career transitions by creating shoreside opportunities for ASOPs in EM programs, thereby increasing workforce stability and employee retention. However, participants also acknowledged the challenge that cross-over between ASOP and EM workforces will not be desirable for everyone within those respective workforces. This may be partly due to the lifestyle of ASOP, and the requirements of EM personnel that can include long office hours and video playback at the entry-level. Additional work may be necessary to further explore the benefits – to fishery managers and at-sea observers – of overlap between ASOP and EM workforces and what, if any, incentives may improve workforce stability.

Theme 3. Data management/use challenges of EM versus ASOP - This theme covered the similarities and differences of EM and ASOP data management and use, and its implications when combining EM with existing ASOP or other monitoring programs.

Breakout groups discussed opportunities to build overlapping and complementary programs that maximize the value of both monitoring tools while minimizing costs (e.g., ASOP used to collect data for science, while EM is used to collect data for compliance). However, participants also noted processing and/or data lag concerns that are particular to

EM programs and impede real-time fisheries management. While delays may be addressed as EM programs mature and if real-time transfer of EM video/data is widely adopted, in the near-term, time lags with EM relative to ASOP will be typical (e.g., hard drives being mailed in after completion of a trip). As EM programs increase in prevalence and use, participants noted that program design should identify time-sensitive data elements and strive to expedite this information for management.

3. Workshop Recap

Following the breakout discussions, groups reconvened to share any key takeaways from their discussions. This was followed by a workshop recap presentation by Claire van der Geest (Seven Seas Consulting) that highlighted the following observations about each of the workshop themes.

Theme 1. Operations, deployment, and logistics of EM versus ASOP

- Risk to observers is a serious and ongoing challenge. EM could be a tool to mitigate some of that risk but this is not a trivial challenge.
- A lack of fisheries data is driving demand for EM and international negotiations on the use of the tool. But, in many fisheries there is still limited or even no verified data and limited dialog on the importance of increasing verified data collection.
- There are many fisheries with no or minimal verified data, and in these cases any EM data can provide significant benefit.

Theme 2. Employment implications of EM versus ASOP

- EM is not likely to be used in all instances and there will be continued need for a skilled observer workforce.
- EM programs may change how the observer workforce is deployed, with opportunities for observers to deliver both at-sea and shoreside services, but there can be concerns about implications of this change.

Theme 3. Data management/use challenges of EM versus ASOP

- A big challenge is how best to combine EM and ASOP data to garner deeper management insights
- More dialog is required to set appropriate levels of uncertainty/precision in data (particularly with EM) and manage expectations for 100% review.
- Data users should consider how the “camera effect” may impact behavior, including the accuracy of self-reported data.

Extended Abstracts of Oral Presentations

Integrating Electronic Monitoring with Additional Monitoring Tools to Create Robust Fisheries Monitoring Frameworks

Andrew Fedoruk,

Archipelago Asia Pacific, Australia

Technology-based monitoring (Electronic Monitoring or EM) has been successfully used to monitor commercial fisheries for over 20 years and in most regions of the world. EM Programs have typically focussed on collecting data on catch, catch handling and disposition, fishing effort and fishing gear. EM has also been successful in collecting other data including fish lengths and RFID tag information. This presentation uses several case studies of fully operational programs where EM has been integrated with other monitoring programs to provide fishery managers, compliance officers, scientists, industry, and other stakeholders with more robust data sets. Benefits and challenges of such programs are explored together with solutions for further operationalizing this approach.

The design of any fisheries monitoring program begins with the data needs required. These then determine the sort(s) of monitoring tool(s) necessary to meet those needs. Examples of such tools include fisher logs, dockside monitoring, shore-side biological sampling, fisher activity hails, at-sea observers, and EM. Rather than restricting a monitoring program to a single data collection method, several methods can be used in a complementary way to address all of the data needs of the fishery which allows for more complete analysis of the fishery. An example would be assessing the efficacy of various methods by comparing such things as fisher logs with EM and landing data. Combining methods can also allow for the more focussed use of human observers for tasks such as catch sampling while EM can collect more of the time-intensive data such as catch quantities.

As fisheries monitoring covers a wide spectrum of data needs, program design is often quite complicated in terms of choosing the best tool or tools to meet the requirements in a way that meets or at least tries to balance economic, social, regulatory, and industry needs. This is not an easy task and often we find that the design of the program can precede having very clearly defined requirements, or that they experience change very quickly after implementation.

Integration of fisheries monitoring tools can take a number of different forms:

- Using multiple but exclusive tools for monitoring a fishery (for example, within a fleet, some vessels use EM, some Observers),
- Using multiple tools to collect different data (for example, on the same vessel use EM to collect effort data and Observers to collect samples),
- Using tools for different objectives (for example, Observer to collect fisheries data and EM for monitoring Observer Safety),

- Using tools to complement (i.e., EM and Fishing Logs to collect similar data and then compare them across these sources).

For this presentation, the latter case of using different tools in a complementary way is considered. Specially, how to consider various tools with consideration of their data strength and economics. These types of considerations could then be used to build a monitoring framework.

Table 1 shows some of the major monitoring tools used with a high-level characterisation of these in terms of what data they are capable of collecting, some of the constraints that these may have, and some associated costs for scale.

Table 1. Fisheries Monitoring Data Sources

Source	Data Capture						Reliability	DQ Verifiable	Base Program Cost ($/SD)*1
	Catch		Effort	Compliance	Sampling				
	By Area	Total			By Area	Total			
Fisher Logs (Self-reporting)	Yes	Yes	Yes	Partial	Partial	Partial	Qualified	No	~$5-10
Observers (3rd Party)	Yes	Yes	Yes	Yes	Yes	Yes	High	No	~$1,000+
EM (3rd Party) - Full Review*2	Yes	Yes	Yes	Yes	Monitored	Monitored	High	Yes	~$300
EM (3rd Party) - 10% Review*2	Yes	Yes	Yes	Yes	Monitored	Monitored	High	Yes	~$100
Dockside	No	Retained	No	Partial	Partial	Yes	High	No	~$75

*1 *Costs based on averages or estimates - actual program costs vary depending on regional labour costs and specific requirements*

*2 *Includes Equipment, servicing, and data review*

For catch, this is quite similar data across the various tools though DMP only has exposure to the retained catch. Similarly, effort (location and time of fishing events) is not visible to DMP.

Compliance is more complicated depending on the program and regulations and is not considered in this analysis.

Sampling is a critical aspect and has a number of interesting elements:

- ASOP provides samples in real time by high-resolution area,
- Fisher logs provide real time by high-resolution area, and can be either self-reported or monitored by EM,
- DMP has a lower resolution in terms of area (depending on the range of fishing and size of management areas). However, with crew cooperation, catch can be segregated to increase the resolution.

Data reliability can be subjective and often relates to whether it is independent or not. Verifiable in this analysis refers to if there can be data quality processes involving a second review. In EM this exists as multiple people can review the same video footage any number of times. This is not possible with observation-based data collection systems.

Costs presented are for illustrative purposes but are based on real experience. They highly depend on program design and jurisdiction (labour rates). For EM this includes equipment supply and maintenance, and data review. Costs presented are in Australian dollars.

The first case study is the Australian Tuna program. This is a fleet of approximately 40 pelagic longline vessels with an EM program starting late 2014. The fishery and monitoring objectives are similar to many monitoring programs and include catch and effort, protected species monitoring, monitoring of seabird interactions, and catch handling. The integration component for this program is in the use of EM to audit the fisher logs which are used as the primary data source for the fishery. As the 10% audit is randomized, the presence of the EM drives higher levels of data quality in the self-reported data. Costs for the addition of the EM component to the program are estimated at $100 per sea day.

The second example is from a Canadian Program where the fleet is larger and more diverse. This fleet consists of approximately 185 vessels fishing a variety of gear types such as demersal longline and traps. The objectives are similar to the Australian program with the addition of a quota element.

The Canadian program builds on the audit model as it also incorporates DMP. This allows for the same 10% Audit between the fisher logs and EM for all catch, but further allows for 100% comparison of the retained catch by species between the fisher log and DMP. The Quota system has an area component, and the program uses actual DMP weights with area allocations from the effort data by area from EM. The costs for this program are approximately $175 per sea day.

Table 2 table provides a summary of the benefits and costs of single source programs and the integrated ones. There is a wide range in cost per sea day across fisheries tools and by combining elements, the ability to cross-check data is created, and this is a powerful tool in increasing the data reliability economically.

Table 2. Costs and Benefits of Integrated Programs

Single Source Models

Source	Cost ($/SD)	Data	
		Reliability	Cross-reference
Fisher Logs	~$5-10	Qualified	No
ASOP	~$1,000+	High	No
100% EM	~$300	High	No

Integrated Models

Source	Cost ($/SD)	Data	
		Reliability	Cross-reference
Fisher Logs + ASOP	~$1,000+	High	1 Level: ASOP to F-Log
Fisher Logs + 100% EM	~$300	High	1 Level: EM to F-Log
Fisher Logs + 10% EM	$100	High	1 Level: 10% Audit EM to F-log
Fisher Logs + 10% EM + DMP	$175	High	2 Levels: 10% Audit EM to F-log;

In addition, combining elements allows additional functionality to the program. For example, using at sea data to provide high resolution to actual offloaded weights of fish obtained at the dock. Or, using a dockside observer, already present at the offload to collect samples from the trip.

In summary, the paradigm of simple replacement of one tool for another is an incomplete one. A mix of tools and costs can be used to calibrate the program requirements depending on the fishery data needs, error tolerance, and costs. Integration greatly increases the data reliability at relatively small incremental costs, especially when compared with 100% programs.

Implementation of Electronic Monitoring Programs alongside At-Sea Observers in the North Pacific Observer Program

Joel Kraski

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Background

Historically, key difficulties in the monitoring and management of fisheries have been funding, staffing, and the ability to place at-sea observers aboard vessels. The North Pacific Observer Program (NPOP) has worked to mitigate these difficulties through the implementation of electronic monitoring (EM). The NPOP has increased target coverage rates for several fisheries in the Gulf of Alaska while also implementing an experimental EM program in the full and partial coverage Pollock trawl fisheries.

While other EM programs have been implemented effectively, it is the real time management of EM alongside observers that sets the NPOP and our monitored fisheries apart. The current design implements data from the EM program directly into our catch accounting system which contributes to daily quota management.

Sector (2021)	Trips	Sampled Trips
Trawl – Full Coverage	1,849	1,849
Trawl (EM) – Full Coverage	999	999
Trawl – Partial Coverage	638	145
Trawl (EM) – Partial Coverage	432	142
Fixed Gear – Partial Coverage	2,258	356
Fixed Gear (EM) – Partial Coverage	923	256

EM Program Overview

An EM option was required as part of the 2012 restructuring of the North Pacific Observer Program for vessels in the partial coverage fixed gear category. Exempted Fishing Permits (EFPs) are requested by industry to field test potential regulations prior to entering regulatory status. The fixed gear EM EFP began in 2013, and then entered regulatory status in 2017. As of 2023, there are 179 vessels participating in the fixed gear EM program across longline, traditional pot, and slinky pot gear types.

Vessels in both the regulatory fixed gear and experimental trawl EM programs annually opt in or out of the programs between September 1 and November 1 each year. Once a vessel has opted into EM, all subsequent trips must be logged in the Observer Declare and Deploy System (ODDS) for the remainder of the calendar year. Footage from EM selected trips is reviewed by the Pacific States Marine Fisheries Commission and feedback is provided to the vessels.

Fixed Gear Category	Anticipated 2023 Coverage
No Selection	0%
Hook-and-Line	18%

Pot (Traditional/Slinky)	17%
Electronic Monitoring	30%

The Trawl EM EFP, which began in 2018 in a non-regulatory status, but is anticipated to enter regulatory status in 2025. As of 2023 there are 79 vessels participating in the Trawl EM program, and Alaska Pollock is the only target species.

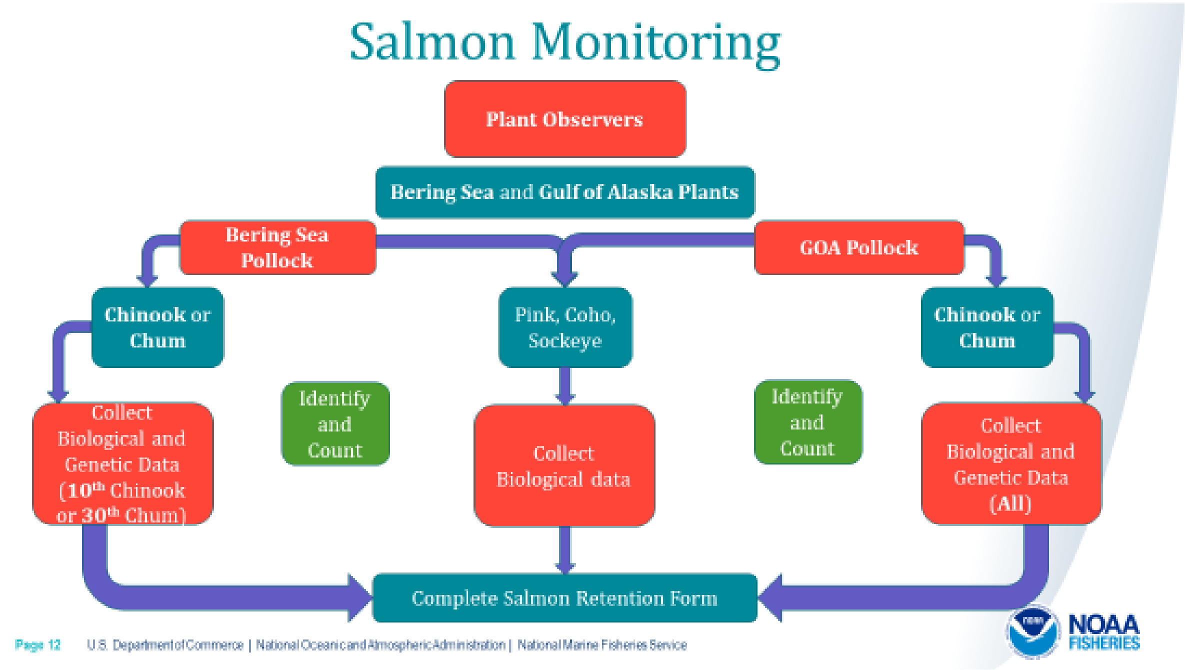
Prior to the Trawl EM EFP, vessels targeting Pollock in the Bering Sea / Aleutian Islands (BSAI) maintained 100% observer coverage, and vessels in the Gulf of Alaska (GOA) maintained 23% observer coverage. Under the Trawl EM EFP, coverage rates for the BSAI vessels remained at 100%, and GOA vessels increased to 33% coverage. To account for what would be collected by At-Sea observers, shoreside EM observers are placed at shoreside processing plants to collect specimens and species composition data. Table 3 illustrates the comparison of biological samples collected by At-Sea observers versus those collected by shoreside observers from randomly selected EM offloads.

Table 3. Biological Specimen Types and Collection Numbers for Bering Sea and Gulf of Alaska.

BSAI Pollock Biological Specimens	At-Sea Observer Hauls	Shoreside EM Offloads
Sex / Length (Pollock)	~ 20 (Every Haul)	~ 100 (Every Offload)
Associated Weights (Pollock)	~ 10 (Random 5th Haul)	~ 10 (Every)
Otolith Pairs (Pollock)	2 (5th)	2 (Every)
Unsexed Lengths (Squid)	~ 20 (Every)	~ 100 (Every)
Lengths (Rougheye Rockfish)	~ 5 (Every)	~ 25 (Every)
Otolith Pairs (Rougheye Rockfish)	5 (Every)	25 (Every)
Lengths (Sablefish / Black Cod)	~ 5 (Every)	~ 25 (Every)
Pacific Halibut Condition	~ 10 Viability Assessments (Every)	Measure and Assess All Halibut
GOA Pollock Biological Specimens	**At-Sea Observer Hauls**	**Shoreside EM Offloads**
Sex / Lengths (Pollock)	~ 50 (Every Haul)	~ 150 (Every Offload)
Associated Weights (Pollock)	~ 8 (Every)	~ 25 (Every)
Otolith Pairs (Pollock)	8 (Every)	25 (Every)
Lengths (Pacific Cod)	~ 10 (Every)	~ 30 (Every)
Otolith Pairs (Pacific Cod)	1 (Every)	5 (Every)
Pacific Halibut Condition	~ 10 Viability Assessments (Every)	Measure and Assess All Halibut

Salmon Monitoring

The monitoring of salmon species in the North Pacific is a critical element of the NPOP's management of the Pollock fishery. All salmon delivered to shoreside plants by vessels monitored by At-Sea observers or EM coverage are counted and randomly sampled for biological data (Chinook and Chum salmon).



Conclusion

Implementing EM alongside At-Sea observers has allowed the NPOP to increase overall coverage and salmon monitoring, simultaneously collect biological data that would normally be lost in a fully EM program, and manage our fisheries in real time. The benefits of EM come with shortfalls that only the human element can account for. Observers are able to bridge the gap and collect biological data, make decisions, and provide an in-person perspective – Things a camera cannot do.

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Workshop 3 – Funding Observer Programmes

Leader: Jennifer Ferdinand

NOAA Fisheries Alaska Fisheries Science Center's Fishery Monitoring and Analysis Division

Introduction

The creation of comprehensive, high quality information systems for fisheries have long term benefits and are highly valued but they do come at a cost, particularly when there is a need for independent monitoring with electronic monitoring (EM) or observers. The costs are often shared by multiple entities and can have a direct impact on fishing behaviour. Increasingly, the fishing industry is being asked to pay for these information systems, following the principle that users who benefit from the resource should cover the cost of the data needed to support resource management. Regulatory agencies, who represent the public interest of these common property resources, increasingly seek to cost recover these programmes from industry and private sector companies are engaged to carry out the monitoring functions.

This triad - requirements specifier (agency), payer for the service (industry), and provider of the service (private monitoring companies) – sets in play an unusual dynamic when it comes to considering questions like:

- What are the drivers in deciding appropriate approaches to monitor a fishery?
- What are the best practices for scoping monitoring programmes and their costs?
- What can industry afford to pay, both in direct and soft costs (or what is a reasonable amount to recover from industry)?
- What is the best method for cost recovery and to pay for services?
- What strategies can be used to ensure best value and manage costs?
- Are there strategies that can be used to create a market for fishery data, thereby providing funds to offset monitoring costs?

Participants

IFOMC delegates with wide representation across the globe participated in the workshop, resulting in varied funding models being represented. The delegates had a range of experience in monitoring programs and their funding models, and different professional backgrounds, including fishery observers; fishery managers; and observer and EM provider company representatives.

Summary

An introductory presentation was provided with an overview of common methods used to fund monitoring programmes, including the following:

1. Government funding: Governments can provide funding for monitoring programmes through their budgets, as well as through grants and other financial support mechanisms. This is a common approach in many countries, as it helps to ensure that monitoring programmes receive the necessary resources to be effective.

2. Industry funding: The fishing industry itself can also contribute to the funding of observer and EM programmes. For example, fishing companies can pay fees to cover the costs of observer coverage on their vessels, or they can provide funding through industry associations or trade organizations.
3. Non-profit organizations: Non-profit, non-governmental organizations (NGOs) can also provide funding for monitoring programmes. For example, environmental groups, conservation organizations, and research institutions can support observer programmes through donations or grants.
4. International organizations: International organizations, such as the United Nations, can also provide funding for observer programmes. For example, they can provide funding through programmes designed to support sustainable fishing practices and the protection of the marine environment.
5. Private sector investment: Private sector investment can also play a role in funding monitoring programmes. For example, companies in the fishing industry, or those with a vested interest in sustainable fishing practices, can invest in observer programmes to support their goals.

Workshop participants self-identified the methods used to fund the monitoring programmes in which they worked, or which were operating in their geographical regions. Participants then broke into smaller discussion groups to address the following challenge questions:

1. Who are your data users? Can they fund all or portions of your monitoring program?
2. What can industry afford to pay? What is a reasonable amount to recover from industry?
    a. In cost recovery programmes, what is the best method for cost recovery and to pay for services? (E.g., product value fees; industry pays directly for monitoring; set-aside harvest to fund monitoring, etc..)
3. What barriers did you (or do you) face in funding your monitoring program?
    a. How did others in the discussion group overcome similar barriers (or suggested solutions from the group)?

<u>Outcomes</u>

Each discussion group summarized their discussions at the end of the workshop, presenting the following perspectives on the challenge questions.

1. Who are your data users? Can they fund all or portions of your monitoring program?

Data users across the represented programmes spanned the gamut: government fishery managers; fishing industry for self-management (e.g., fine-resolution quota management and hot-spot or "move-on" rules associated with bycatch avoidance); fishery certification entities; government and non-government scientists, including for stock assessments; and marine law enforcement entities. Fishery-dependent data is a rich data source, and participants noted that the original data users may no longer be the only, or even largest, set of data users as a monitoring program grows and matures. Additionally, because so many monitoring programmes have multiple objectives, developing a cost model associate with data types is complicated.

2. What can industry afford to pay? What is a reasonable amount to recover from industry?

   In cost recovery programmes, what is the best method for cost recovery and to pay for services? (E.g., product value fees; industry pays directly for monitoring; set-aside harvest to fund monitoring, etc..)

There was robust discussion about recovering costs – or directly requiring the monitoring costs to be borne by the fishing industry through pay-as-you-go cost models. Many participants reflected public sentiments that those who have the right to harvest fish and profit from that harvest should pay for the necessary monitoring – especially if those rights are exclusive or limited. However, this model works best for larger, or high value fisheries where the data needs can be supported by the economics of the fishery. It was noted that the term "industry funding," itself incorporates a number of models including: landing fees; direct pay-as-you-go with vessel operators paying observers or EM providers directly; licensing fees; observer or placement fees; and cost recovery plans.

Delegates also noted that when industry is funding monitoring, what data are required has to be carefully considered. For example, while there is common agreement that stock assessments are necessary, the fishing industry may not realize immediate benefits from an assessment and therefore it can be difficult to recover costs associated with fishery-dependent data collections used in the assessment. Similarly, costs associated with the shore-based work associated with monitoring programmes are more difficult to recover. These activities include management (e.g., administering contracts, recruiting and training observers); logistics (e.g., deploying observers and EM systems; examining vessels or processors in advance of observer or EM placement), and administration (e.g.; creating and maintaining data systems; establishing coverage levels). These infrastructure functions are critical, but are often unseen by the monitored fishery, and therefore not always considered recoverable.

3. What barriers did you (or do you) face in funding your monitoring program?

   How did others in the discussion group overcome similar barriers (or suggested solutions from the group)?

Given that the delegates all represented active monitoring programmes, this discussion focused on challenges of changing – or incorporating additional – funding models into their programmes, and on funding new aspects of a monitoring program, especially incorporating EM into traditional observer programmes.

There was discussion in both workgroups about the barriers faced when moving from government funding to industry funding. In programmes where this shift had been accomplished, or is being attempted, this change is particularly fraught as there is industry resistance in passing additional costs along, and smaller vessels, small fisheries, or low-value fisheries may not be able to absorb those costs. Politically active harvesters may leverage this power to prevent these costs being passed along as well.

It was noted that monitoring programmes could also benefit the economics of a fishery through enabling certifications in sustainability. Products in these fisheries may demand a premium in the market, but it’s not clear if this premium can offset the costs of monitoring.

Both breakout groups discussed the importance of NGOs when developing new monitoring programmes, and noted that NGOs were particularly helpful to stand up monitoring programmes to address project-specific or fishery-specific objectives. It was noted that the NGOs may have priorities that don’t always share the needs of the fishery-management agency, and managers should seek to ensure that nexus. Additionally, NGOs are rarely – if ever – designed for long-term, multi-objective monitoring programmes.

Conclusion

In conclusion, funding for fishery monitoring programmes can come from a variety of sources, and a combination of these approaches can be used to ensure the long-term sustainability of the programmes. It is important to ensure that monitoring programmes receive adequate funding to enable them to carry out their important work effectively.

Workshop 4 – Fisheries Certification

Background

The original concept for this workshop was suggested by the Marine Stewardship Council - an ecolabelling entity - who wished to focus on the evaluation of observer and electronic monitoring as part of fishery ecolabel certification. Noting that monitoring requirements for certification standards are an important topic for many fisheries globally, the IFOMC Steering Committee requested that several (as many as possible) ecolabelling organisations participate and, with the assistance of conference delegates and an independent Chair, help identify those aspects of monitoring design, sampling procedures, equipment type and placement, data governance, training and programme management that are important to consider in assessing a fishery's certification for an ecolabel.

Unfortunately, the only ecolabelling certification scheme that attended the conference was the Marine Stewardship Council. Therefore, the delivered workshop mainly focussed on that organisation's scheme, standards, requirements, terminologies, etc. The below report summarizes the materials that were presented at workshop, and the outcomes generated which can be applied to any certification scheme.

The IFOMC SC would note that the materials and outcomes presented regarding the MSC and its Evidence Requirements Framework do not constitute an endorsement of the company and its certification standards by individuals or organisations that attended and sponsored the IFOMC 2023 conference.

Fisheries Certification Workshop

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Introduction
In recent decades, the use of sustainability ratings, voluntary standards, certification schemes and ecolabels have been increasingly adopted in nearly every commercial sector in a bid to create market-driven incentives for the adoption of sustainable practices (FAO 2011, Bullock and van der Ven, 2020). This includes the fisheries sector, where a drive to improve fisheries sustainability has led to the development of certification and ecolabelling schemes intended to influence the purchasing decisions of consumers and the procurement policies of retailers and food services selling fish and seafood products, as well as to reward fisheries engaging in responsible fishing practices (FAO, 2011). A range of certification and rating schemes exist, each with their own scope, criteria, processes, levels of transparency and sponsors. What is covered by each scheme can vary considerably: bycatch issues, fishing methods and gear, sustainability of stocks, conservation of ecosystems and social and economic development. The sponsors or developers of standards and certification schemes for fisheries sustainability also vary – private

companies, industry groups, non-governmental organizations (NGOs), national bodies and combinations of stakeholders (FAO, 2011).

The Marine Stewardship Council (MSC) is a non-profit organization that sets a standard for sustainable fishing. The science-based MSC environmental standard for sustainable fishing (MSC Fisheries Standard) offers wild-capture fisheries a way to confirm sustainability, using an independent, third-party assessment process. Fisheries that wish to demonstrate they are well-managed and sustainable compared to the MSC Fisheries Standard are assessed by independent Conformity Assessment Bodies. If certified, fisheries can use the blue MSC ecolabel on their products. This allows sustainable fisheries to be recognized and rewarded in the marketplace, and provides assurance to customers that their seafood comes from a well-managed, sustainable source. Fishery certification lasts five years from assessment, with fisheries audited annually during their certification cycle to review any changes in information and check on progress made against any conditions of certification.

The MSC recently released a revised Fisheries Standard (v3.0), effective from May 2023, which includes a new framework for assessing the accuracy of information used in fisheries certification - the MSC Evidence Requirements Framework (ERF). These are significant new requirements that put greater focus on the quality of fishery information needed for MSC certification. Fisheries must be assessed against the revised Fisheries Standard (including the ERF) in order to maintain, or gain, MSC certification.

This workshop focused on the design of fishery monitoring regimes (including observer and electronic monitoring schemes) in the context of the revised Standard, focussing on how monitoring regimes can improve performance against the ERF. The workshop was solutions-focussed, with participants called on to suggest tools and approaches that could be used to overcome potential barriers to fisheries meeting the standard required by the ERF.

While this workshop focussed on the MSC Fisheries Standard and ERF, improving the accuracy of information generated by fishery monitoring systems is an issue that also holds importance beyond the MSC program. Issues discussed and conclusions drawn in the workshop could serve to inform fishery managers, monitoring providers or other certification and rating schemes.

Objectives

The workshop objectives were to:

- Engage experts on tools available to improve the quality of fishery information.
- Discuss creative and innovative ideas for solving monitoring challenges, using suggestions to inform ongoing work to develop additional technical guidance on assessing and improving the information accuracy of monitoring systems used in different fishery contexts.
- Raise awareness of the implementation of the ERF.

Participants

Ninety IFOMC delegates participated in the workshop. These included delegates from 22 countries and from a range of professional backgrounds, including:

- Fishery managers (government & Regional Fisheries Management Organisation representatives)

- At sea observer providers (including observers)
- Electronic monitoring providers
- Environmental NGOs
- Research institutes
- Environmental/fisheries consultants

An introductory icebreaker found a range of understanding of the MSC program in the room. Approximately 15 participants raised their hand to say they had been actively engaged in the MSC program (i.e., working directly with the MSC, Peer Review College, Conformity Assessment Body or to support the certification of a fishery engaged with the program). One person stated they had no knowledge of the MSC program. The majority of participants had some awareness but limited direct engagement with the MSC program.

Workshop summary
An introductory presentation was provided, reviewing and expanding on the information provided during Elise Quinn's presentation on the ERF during Session 1 of the conference (see earlier in this document). An independent assessor then spoke through an applied example of the ERF. After an opportunity for questions and answers, participants were broken into groups to undertake two breakout tasks.

Group task 1: Focal issues – considering challenges for fisheries implementing the ERF

The room divided into five groups for this session, with each group considering one of the following focal issues:

	Focal issue	Summary
1	Monitoring design: Sampling design and protocols	Animals caught that are difficult to ID to species level and are released in the water (not brought onboard). For example, longline captures of sharks and mobulid rays.
2	Monitoring design: Cryptic interactions/ mortalities	Interactions may occur with catch species that are observable but undetected. For example, seabird interactions with trawl warps and vessel structures.
3	Monitoring design: Data protocols	Management agency seeking to consolidate analogous data collected using different monitoring methods, i.e. ensuring continuity of time series data when incorporating a new monitoring method.

4	Monitoring design: Sampling for shark finning	MSC requires a 'fins naturally attached' (FNA) policy in place for all retained sharks and that there is robust evidence of this. In some cases observers are deployed on vessels in a fishery but observations of shark finning are conducted an ad hoc basis, rather than being monitored systematically or comprehensively.
5	Institutional arrangements: Scheme management and funding	*Scheme management:* Catch monitoring systems that are not managed independently of an assessed fishery present a perceived conflict of interest. *Funding:* Conflicts of interest can occur within funding structures. Fisheries implementing improvements to their catch monitoring system require affordable monitoring systems and the best return for investment on monitoring, but need to ensure any bias is mitigated.

A summary of the discussion points and conclusions from each focal issue/group are provided below:

Focal Issue 1: Monitoring design - Sampling design and protocols

<u>Drawing on industry knowledge</u>
The group noted the importance of recognising technical knowledge of crew, highlighting that often the best first course of action is to ask vessel crew if there's a clear technical solution to the problem. This would also support industry buy-in.

<u>Considering alternative monitoring approaches</u>
- Photo identification, if possible, i.e. consideration of video monitors on hauling bays that can be reviewed later
- Collection and/or use of other data that could be used as proxy information to narrow down identification (i.e. water depth, location, temperature)
- Consider eDNA potential
- Employing an expert to monitor lines
- The use of fishery independent surveys, i.e. with ROVs

<u>Training</u>
Adequate training can mitigate risk, including the provision of training for:
- Species ID (including provision of onboard ID guides)
- Effective animal release
- Clarifying that species level ID should not be done where it is not possible to distinguish an animal to that level.

<u>Considering barriers to adoption of measures:</u>
- Cost and time implications of training where you have high crew turnover therefore a need for constant training no penalty for effective reporting
- Industry buy-in where there is a feeling of being penalised for effective reporting

- Significant costs of many monitoring approaches, in particular if they need to be used in combination (i.e. at sea observers + camera installation)

Focal issue 2: Monitoring design - Cryptic interactions/mortalities

Setting monitoring objectives:
The group highlighted that the first step to an effective program is defining clear monitoring objectives and then selecting the most appropriate tool(s) to achieve this.

Considering mitigation as well as monitoring:
The group highlighted that if there is a mitigation measure known to be 100% effective, this can demonstrate that the issue is negligible, regardless of whether monitoring is in place. This could also include number of management tools, i.e. exclusion zones, gear modifications, seasonal closures, etc. With these, there will always be a cost-benefit analysis/decision for the fishery to make.

Designing an effective monitoring approach:
- First consider work by other fisheries/systems and how that information can be applied to the fishery context
- Consider monitoring at the population level, and using data effectively from population level monitoring and mitigation measures to reach conclusions on impact
- Highlighted that in this case there isn't much vessel crew can do, it would need to be observers or electronic monitoring in situ.
- Consider how other data sources can be used (i.e. fishing location information, self-reported catch data, etc.)
- Ensure the precautionary approach is implemented
- Work on industry buy in to any changes to management/monitoring and consider how to increase confidence in self-reported data

Focal issue 3: Monitoring design - Data protocols

Considering the information available from the current program:
The group discussed what catch composition data actually is, concluding that it can mean a whole host of things depending on the context. For example, it could focus just on catch volume/numbers, or could include data on age/maturity if at sea observers have historically been the main data collection method. This is key to ensuring data continuity, with data compatibility between the previous and new system critical to effective management.

Trialling approaches:
The group suggested always starting with a pilot/trial if implementing EM. Overlapping EM and observers to understand the data that each can collect and the accuracy of this information. In a theoretical fishery context, the group suggested starting with a 10% EM implementation coverage.

Considering the level of coverage required:

The group suggested using the available information to consider the level of coverage that is required and whether observer coverage could be reduced over time with the implementation of EM (and indication of its success). Power analyses can support this.

Implementing effective approaches:
If pilot projects prove successful, the team recommended adopting these monitoring methods. The team recommending looking to implement EM at high up to 100% levels, with post-trip review selection at a lower coverage level. EM would support catch data collection and encourage compliance. The consideration would then shift to ensuring continuity in the collection of any biological data. Approaches that could be considered include:

- Continued use of at-sea observers to collect biologicals
- Self-sampling schemes, where fishers collect biologicals
- If a naturally low discard fishery, consider dockside sampling

Focal issue 4: Monitoring design - Sampling for shark finning

The group discussed the options available for effectively monitoring shark finning incidences and their limitations/advantages.

At-sea observers

- Limitations include that observers are duly entitled to rest days (data can be missed), availability of observers for high coverage program can be difficult, that the safety of observers must be considered and intimidation of observers can result in systematic error in data

Electronic monitoring

- Can provide higher coverage levels in the face of limitations of at-sea observers
- Limitations include coverage rates (data can be missed), camera positioning on vessels and species level ID.
- Solutions: One participant highlighted the approach of attaching a secondary camera on masts/a high point, while another participant highlighted the use of the precautionary approach to assume any shark taken out of view of cameras has been finned.

Dockside monitoring

- Some fisheries compensate for low observer coverage by requiring the unloading of all vessels in specified ports and sampling to ensure FNA policies are enforced.

Alternative approaches

- Underwater cameras: would come with significant costs but could look at discards and may provide better species level ID than standard EM.

Focal issue 5: Institutional arrangement - Scheme management and funding
The group discussed the following approaches to ensuring legitimacy of industry-driven monitoring schemes:

- Work with regulators and industry bodies to establish monitoring standards and audit checks on systems/vessels

- Introduce requirements for mandatory reporting of data
- Consider data governance:
    - Operating procedures/chain of custody for data handling would be needed regardless of monitoring approach
    - Ensure data feeds into an integrated system that can be queried by others
- Consider linking monitoring standards to licenses/access rights as an incentive
    - Consider co-monitoring contracts with government associations
- Ensure separation between fishers and observer – i.e. use independent/certified providers, with observers debriefed by regulators or providers
- Consider how MSC can showcase leaders in the area, where industry has developed effective monitoring programs, offer up/pinpoint these examples to other fisheries looking to do the same
- Consider funding and how to ensure there is no fear of reprimand if observers report negative findings
    - Consider up-front pay or commitments independent of what is reported
- If monitoring is not set up independently of the fishery, the fishery should consider from the start a transitional plan/approach to moving it to being run independently

Group task 2: Considering practical solutions for case study fisheries

During the second group task, the room split into 3 groups:

Group 1
Group 1 were tasked with considering an artisanal pole & line and troll tuna fishery. The fishery currently has a catch monitoring system in place that collects and provides catch information, including independent verification and some independent observation of catch. The fishery is managed by a Regional Fishery Management Organisation, operates on the high seas and has Endangered, Threatened, and Protected species (ETP) interactions. Therefore, to meet the requirements of the MSC Fisheries Standard v3.0, the catch monitoring system will need to include independent observation at a rate of at least 30% coverage to pass without a condition for the ETP information scoring issue. A 30% coverage level is significantly higher than the fishery's pre-COVID level of coverage (~5%).

The group recommended a move towards 100% coverage, firstly implementing electronic monitoring on all vessels with a first phase that reviews 30% of electronic monitoring imagery and associated data. They recommended doing a risk assessment on bird interactions after the implementation of phase 1 and adjusting coverage rates accordingly to ensure the level of precision is appropriate for the species interacted with. They recommended the fishery maintain current levels of observer coverage, but that observers were spread more widely across the fleet, to function as EM system verifiers and to collect any biological data required.

Group 2

Group 2 considered a small-scale, data-limited lobster fishery. Fishers free dive for catch, with limited interactions with non-target species. While there is limited to no bycatch, empirical confirmation of this situation is required. There is some information currently collected through landings forms, processor reports and reports from fishery enforcement officers. Information from outside the fishery is also used to support the fishery's certification, in particular studies on interactions with endangered, threatened and protected species in similar fisheries. The fishery is data-limited in a number of areas, including that not all catch is covered by the data-collection system.

The group recommended:

- Implementing a fishery independent dive survey (possibly annual) across the fishery to determine:
    - Interactions with non-target species (including ETP)
    - Improved biomass estimates
    - Scale and compliance of gear
- Trialling small-scale electronic monitoring systems where cameras are either attached to a small percentage of pots throughout the duration of the season or carried by dives. These cameras could provide information on interactions with non-target species.
- Trialling and testing gear adaptation/modifications to fully mitigate against ETP interactions
- Considering alternative funding sources given that the government is unlikely to have capacity to provide additional funding/resources – consider reaching out to NGOs for funding.
- Working to ensure non-mandatory reporting is completed effectively & build trust in self-reported data.
- Using available, qualified third parties to provide services, i.e. for electronic monitoring or independent dive surveys.

Group 3

Group 3 considered two fisheries. The first was a hand-raked intertidal shellfish fishery with limited interactions and bycatch of non-target species. The fishery has a catch monitoring system in place that can estimate catch information, report it to relevant authorities and provide independent verification of catch. Information is collected independently from the fishery by the competent authority, with no known risks of conflict of interest. While there is independent verification (dockside monitoring) of catch, it is unclear from reports whether there is any 'independent observation' of catch. There is some indication that fishery enforcement officers do 'walkover' surveys of beds while the fishery is open but this is done on an ad-hoc basis and is not currently part of the catch monitoring design.

The group suggested the following potential solutions to the current lack of 'independent observation':

- Trialling body-worn cameras for fishers as either a voluntary measure or a condition of licence to see if they could provide this.
- Requesting that enforcement officers act as human observers by planning to spend a proportion of fishing days alongside fishers in a manner that is representative of the fisheries activities, monitoring any wider impacts on non-target species and compliance.
- Consider the use of drones (being aware of potential disturbance to bird species).
- Consider whether there is scope to monitor fisheries from further afield, i.e. telescope view or cameras from a good view point, in particular as this would avoid any safety risk to a human observer and wouldn't increase any impact on the intertidal habitat or associated species.

The group then began to consider a bottom-trawl fishery that has interactions with vulnerable marine ecosystems with the last 5 minutes of the session. The fishery has an effective catch monitoring system in place, however as the fishery has interactions with vulnerable marine ecosystems, they will need to show a catch monitoring system is in place that is able to collect and provide catch information on habitat-forming species. The group recommended the following:

- Mapping out areas where these ecosystems could occur to target monitoring to relevant areas
- Trial the use of electronic monitoring cameras on a discard chute to monitor discarded benthos
- Increasing observer coverage to report interactions with benthos, current coverage rates are ~5%

Workshop summary

The workshop emphasized the critical role of fishery observers and electronic monitoring in ensuring the sustainability of fisheries, with a particular focus on certification against the new MSC Fisheries Standard. Participant contributions emphasised different approaches to meeting the requirements of the new ERF using observers and electronic monitoring, complemented by other monitoring methods. Proper sampling design and effective monitoring were highlighted as crucial in collecting accurate data on fish populations and fishing practices, and the ecosystems impacted by fisheries. By providing reliable, independent information, fishery observers and electronic monitoring, together with other monitoring methods, help to build public confidence in the sustainability of seafood products and support the long-term viability of the fishing industry.

Workshop participants generated a number of creative and innovative ideas to approach monitoring challenges through the use of the case study fisheries. They also provided illustrative examples of how fisheries could consider developing and implementing their own independent monitoring frameworks. The outputs of this workshop will be directly used to inform a project underway that will provide technical examples of the application of the ERF in different fishery contexts. The ERF and conclusions drawn from the workshop discussions can also be used more widely by fisheries considering designing new monitoring frameworks or improving information accuracy within existing catch monitoring systems.

References

Bullock, Graham, and Van Der Ven, Hamish (2020). The shadow of the consumer: Analyzing the importance of consumers to the uptake and sophistication of ratings, certifications, and eco-labels. *Organization & Environment, 33*(1): 75-95.

FAO (2011). Private standards and certification in fisheries and aquaculture. Current practice and emerging issues. FAO Fisheries and Aquaculture Technical Paper 553. ISBN 978-92-5-106730-7

Best Poster Awards

As with all our previous conferences, in keeping with our desire to highlight the all-important poster presentations, we only give awards for what are judged to be the best posters presented.

At this conference the number and quality of posters was truly remarkable and resulted in excellent and interactive Poster sessions throughout the week as well as during the dedicated evening poster reception. All conference attendees scored all the posters presented and decided on the following winners:

First Prize:

Developing Electronic Monitoring in Pacific Island Countries and Territories Closing the data gap in Longline Fisheries

Leontine Baje, Malo Hosken, Timothy Park, Eparama Loganimoce

Pacific Community, Noumea, New Caledonia

Second Prize:

Digital Media in Observer Training: Using digital media to teach, recruit, and potentially reduce anxiety and other mental health issues related to observing

Brad Laird

West Coast Groundfish Observer Program, United States

Third Prize:

Monitoring the Commercial Fisheries of the North Pacific

Gwynne Schnaittacher and Jennifer Cahalan

Pacific States Marine Fisheries Commission, United States

Congratulations to our winners and to all the poster presenters for their fantastic displays.

Concluding Session and Discussion

Comments from the Conference Chair

The Conference Chair, Isaac Forster began the concluding session by noting that this conference has had a total of 233 delegates representing 30 countries (11 of which were from the South Pacific) - the maximum that the venue could hold! A truly outstanding result in this post-Covid era

The feedback received so far from delegates has been really positive. There have been a few requests for talks to be more than 7 minutes but far more comments supporting the format. In fact, the Head of the conference organising company we used (Leishman and Assoc.) - who organises a lot of conferences - said she's never seen a format like this before but that it works really well as people are the most engaged she's ever seen and will be recommending the format to other organisers, which Isaac feels is a compliment.

Isaac concluded by thanking everyone for their attendance and participation. He noted how honoured and proud he and CCAMLR were to have hosted the conference in Hobart, Australia. He then opened the floor for any comments about the conference: what was liked, what wasn't and suggestions for next conference.

Comments from the Open Discussion

Gwynne Schnaittacher initially thought the 7 minute oral presentation limit was ludicrous but the ability to have broader discussions afterwards has been invaluable and much better than being at a conference dominated by slide-heavy presentations.

At the next conference she would like to see industry members speak about their experience with observers. It would be a good panel topic.

Was very supportive of a full workshop just for Observer mental health and well-being, and felt that the health and safety workshop was a little rushed and could have used at least another half an hour.

Also, would really love a stretching zone as we are sitting all day long.

Victor Ngcongo said that at this conference all observers feel welcome and at home, and would like to keep that going. Thanks to NOAA for including observers, it's much appreciated. Recommends having an observer-only panel chaired by observers, sharing their experiences.

Jack Fenaughty has been a commercial fisherman most of his life, and came to this conference mainly to hear about EM and certification. But he found the rest of the conference a real eye opener and really liked the 7 minute time limit. Would like to see more industry participation to get different perspectives. As industry have many of the same problems, especially with respect to COVID, as mentioned in panel discussion on that topic. Thanks very much for the conversations.

Christine Davis suggested a standardised poster template or format outlining how other observer programs are run so that we can have a better concept of what is being talked about and be able to make comparisons.

Staci King agreed with the idea about using the same template for various programs so that comparisons can be made at a glance. Example information on a template could include the number of observers and/or vessels carrying EM, number of fisheries, types of fish, types of fishing gear, how they are funded, etc.

Isaac Forster said that he had been thinking of that but as space is limited for posters, he suggests a page on the website for that information. All agreed.

Debra Duarte noted that it was great to see so many observers but she would also like to see more staff here as well - such as debriefers, trainers and those dealing with the data every day.

She noted that she struggled with the 7 minute format but thought the panel discussions were fantastic but would like to see the panels split up amongst the different regions. Also really appreciated the helpful and thoughtful questions from the audience.

Steve Kennelly noted that the 7 min format has been in place since these conferences began and it works really well. A poster presentation is suggested for those who wanted to convey more information.

Christa Colway noted that it was important to point out the things that are going right. She felt that networking opportunities and break times were spot on. Suggests adding a way to add/communicate/invite people to casual social events on unstructured evenings in the Event app.

Staci King suggested a training session at the beginning of the conference on key features of the app, particularly the meeting hub and ability to scan QR codes on name tags to add to connections.

All agreed that the App was a great addition to this conference.

Andrea Clement was inspired by Janice Ross's Statement to Country at the beginning of the conference and would like to see an indigenous-led panel discussing indigenous approaches to fisheries monitoring. She also echoed that an industry-led panel would be very interesting.

Cameron Desfosses asked if there is any consideration for a hybrid version next conference for those who can't get funding to travel? That is, making presentations available on line?

Isaac Forster noted that this was considered but we considered that the face-to-face format works best, and technology costs of hybrid model were really high. Steve Kennelly also noted that a hybrid model would also result in less people showing up which we wanted to avoid.

A question was posed to observers. Would there be interest in a resume workshop? Perhaps a breakout room for observers to have private conversations or mentoring sessions.

Sifa Fukofuka noted the large presence of Pacific Islanders in this conference and would like to see even more participation from Pacific Nations. Encourages poster presentations as a first start. He also noted, however, that he found that the North American delegates spoke too fast.

Cassandra Donovan suggested that we spread out the posters more during poster sessions as a lot of people crammed into that area made conversations difficult to hear and difficult to engage with the presenter.

Also, she mentioned that, going forward, there seems to be a lot of reinventing the wheel in observer programs and more collaboration would benefit everybody. Encourages anybody in any program to reach out to the broader community. Networking at this conference has been great, in addition to learning about other programs.

Keith Reid really liked the 7 minute oral format and would like all scientists to adopt this. What struck him most about the conference was that people were mostly unaware that somebody on the other side of the world was doing exactly the same job as them. Suggests some sort of observer exchange program to build a legacy between conferences and ongoing (Staci King volunteered as tribute).

Paul Oryem, a self-funded attendee, would like to see some sort of social media, press guide and/or hashtags of threads or concepts being covered, in order to have something to present to employers or funders.

Adriana Myers suggested having a master poster available that details the name, region, number and title of each poster so people could find posters quicker.

Sofie Gundersen suggested being able to write a question down and have it read out - for those of whom English isn't their first language.

Isaac assured all present that the conference organising committee will consider all these very positive and useful comments as we prepare for the next conference in 2 years' time.

The next conference

Finally, it was announced that the next conference, the 11th International Fisheries Observer and Monitoring Conference will be hosted by NOAA Fisheries in:

Hawaii, USA in 2025

See you all there!!

Conference attendees

First Name	Last Name	Organization	Country
David	Agnew	CCAMLR	Australia
Junior Rheinheart	Ajawas	Ministry Of Agriculture and Fisheries-Samoa	Solomon Islands
Henrique	Anatole	CCAMLR	Australia
Haley	Anderson	AIS Inc	United States
Bermy	Ariihee	Ministry of Fisheries and Marine Resources	Cook Islands
Indigo	Atkinson	Australian Fisheries Management Authority	Australia
Leontine	Baje	Pacific Community	New Caledonia
Claire	Baker	Australian Fisheries Management Authority	Australia
Tom	Bangma	Wageningen Marine Research	Netherlands
Amos	Barkai	OLSPS Marine	Portugal
Amanda	Barney	Teem Fish Monitoring Inc.	Canada
Bryan	Bates	Achipelago Asia Pacific	Australia
Benaia	Bauro	Ministry for Fisheries and Marine Resource Development	Kiribati
Phillip	Bear	AIS Inc	United States
Bryan	Belay	MRAG Americas	United States
Jim	Benante	Pacific States Marine Fisheries Commission	United States
Keith	Bigelow	National Oceanic and Atmospheric Administration	United States
Phillip	Bizzell	National Oceanic and Atmospheric Administration	United States
Lisa	Borges	FishFix	Portugal
Anja	Boye	DTU Aqua	Denmark
Eric	Brasseur	Pacific States Marine Fisheries Commission	United States
Carolina	Breakell	East West Technical Services	United States
Melanie	Brenton	Fisheries Division, Northern Territory Government	Australia

Alex	Buffington	AIS Inc	United States
Makbi	Bwijko	Marshall Islands Marine Resources Authority	Marshall Islands
DAVID	BYROM	MRAG Asia Pacific	Australia
Leonardo	Caballero	Instituto de Fomento Pesquero	Chile
Skye	Carson	Department of Natural Resources and Environment Tasmania	Australia
Glenn	Chamberlain	National Oceanic and Atmospheric Administration	United States
Andrea	Chan	ECS Federal In Support Of NOAA Fisheries	United States
Charlotte	Chazeau	Muséum national d'Histoire naturelle	France
Samantha	Chicos	Alaskan Observers Inc	United States
Kiwon	Choi	Korea Fisheries Resources Agency	South Korea
Andrea	Clement	AIS Inc	United States
Luis	Cocas	Undersecretariat For Fisheries - Chilean Government	Chile
Dave	Colpo	Pacific States Marine Fisheries Commission	United States
Christa	Colway	National Oceanic and Atmospheric Administration	United States
Bubba	Cook	World Wide Fund for Nature	New Zealand
Scott	Coughlin	EM4fish	United States
Brian	Cowan	Anchor Lab	Denmark
Brendon	Crowe	Australian Fisheries Management Authority	Australia
Christopher	Cusack	Environmental Defense Fund	United States
Joergen	Dalskov	DTU Aqua	Denmark
Carla	Damaso	Sea Observatory of the Azores	Portugal
Rebecca	Darcy	Australian Fisheries Management Authority	Australia
Christine	Davis	Ministry for Primary Industries	New Zealand
Javier	De La Cal	Satlink	Spain
Daphnis	De Pooter	CCAMLR	Australia
Sander	Delacauw	Flanders Research Institute for Agriculture, Fisheries and Food	Belgium
Cameron	Desfosses	Department Of Primary Industries & Regional Development (W.A)	Australia
Peter	Diema	Nauru Fisheries Marine Resources Authority	Australia

Cassandra	Donovan	NOAA Fisheries - Northwest Fisheries Science Center	United States
Jeff	Douglas	Integrated Monitoring Inc	United States
Debra	Duarte	Northeast Fisheries Science Center	United States
Todd	Dubois	CCAMLR	Australia
Zane	Duncan	Ministry for Primary Industries	New Zealand
Stephen	Eayrs	Fisheries Research & Development Corporation	Australia
Jørgen	Eliasen	Ministry of Food, Agriculture and Fisheries of Denmark	Denmark
Victoria	Escobar	Instituto de Fomento Pesquero	Chile
Craig	Faunce	National Oceanic and Atmospheric Administration	United States
Bailey	Fedors	AIS Inc	United States
Andrew	Fedoruk	Achipelago Asia Pacific	Australia
Jack	Fenaughty	Silvifish Resources Ltd	New Zealand
Jennifer	Ferdinand	National Oceanic and Atmospheric Administration	United States
Kenn Skau	Fischer	Danish Fishermen PO	Denmark
Claire	Fitz-Gerald	National Oceanic and Atmospheric Administration	United States
Vanessa	Fleming	Pacific States Marine Fisheries Commission	United States
Jessica	Ford	CSIRO	Australia
Isaac	Forster	CCAMLR	Australia
Jimmy	Freese	Ai.Fish	United States
Sifa	FUKOFUKA	Pacific Community (SPC)	New Caledonia
Keith	Fuller	Alaska Pacific University	United States
Phil	Ganz	National Oceanic and Atmospheric Administration	United States
Nicolas	Gasco	Muséum national d'Histoire naturelle	France
Katie	Gaughan	AIS Inc	United States
Mike	Gerner	Australian Fisheries Management Authority	Australia
Jamie	Gibbon	The Pew Charitable Trusts	United States
Madi	Green	CSIRO	Australia
Mark	Grubert	Australian Fisheries Management Authority	Australia

James	Grunden	West Coast Groundfish Observer Program	United States
Sofie	Gundersen	Institute of Marine Research	Norway
Mark	Hagianis	Saltwater Inc	United States
Rebecca	Hailey	AIS Inc	United States
Stacey	Hansen	Saltwater Inc	United States
Lesley	Hawn	National Oceanic and Atmospheric Administration	United States
Iain	Hayes	Integrated Monitoring Inc	United States
Craig	Heberer	The Nature Conservancy	United States
Jessica	Hoey	Department Of Climate Change, Energy, The Environment And Water	Australia
Bob	Hogan	National Oceanic and Atmospheric Administration	United States
Graham	Hooper	South Australian Research And Development Institute	Australia
Malo	Hosken	Pacific Community	New Caledonia
NATSUKI	HOSOKAWA	North Pacific Fisheries Commission	Japan
Rachel	Howland	Saltwater Inc	United States
Julian	Itsimaera	Nauru Fisheries And Marine Resources Authority	Australia
Randy	Jenkins	South Pacific Regional Fisheries Management Organization	New Zealand
Lacey	Jeroue	Pacific States Marine Fisheries Commission	United States
Haukur	Johannesson	Marel	United States
Grant	Johnson	Department of Industry, Tourism and Trade	Australia
Justine	Johnston	Australian Fisheries Management Authority	Australia
Tim	Jones	Western and Central Pacific Fisheries Commission	Micronesia
Shems	Jud	Environmental Defense Fund	United States
Yoonsuk	Jung	Ministry Of Oceans and Fisheries	South Korea
Ken	Keene	USDOC NOAA Fisheries NOP	United States
Joseph	Kendou	Parties to the Nauru Agreement (PNA) Office	Marshall Islands
Ali	Kennard	SNAPIT	Portugal
Steve	Kennelly	Achipelago Asia Pacific and IC Independent Consulting	Australia
Staci	King	Ministry for Primary Industries	New Zealand

Roger	Kirkwood	SARDI Aquatic Sciences	Australia
Ogmundur	Knutsson	Directorate of Fisheries, Iceland	Iceland
Lewis	Koplin	National Oceanic and Atmospheric Administration	United States
Stephen	Kostelnik	National Oceanic and Atmospheric Administration	American Samoa
Joel	Kraski	National Oceanic and Atmospheric Administration	United States
Gabriella	Kurz	Alaskan Observers Inc	United States
Manoi Rex	Kutan	Tuvalu Fisheries	Papua New Guinea
John	LaFargue	NOAA Fisheries	United States
Brad	Laird	Pacific States Marine Fisheries Commission	United States
Martin	Lankheet	Wageningen University And Research	Netherlands
Alex	Leander	Marshall Islands Marine Resources Authority	Marshall Islands
Jooyoun	Lee	Department of Fisheries and Oceans	South Korea
Joshua	Lee	National Oceanic and Atmospheric Administration	United States
Kyungseon	Lee	Korea Fisheries Resources Agency	South Korea
Gonzalo	Legorburu	Digital Observer Services	Spain
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