Session 10. How much observer coverage and monitoring is enough? Methods for reducing and/or incorporating biased data collection.

Leader: Liz Scott-Denton

There are many potential sources of bias in the collection and analysis of fisheries data. Examples from observer programs include vessel selection, catch sampling, changes in fishing behavior when an observer is, or is not, on board, and analytical techniques employed in the estimation of catch rates of target and bycatch species (including protected species). In this session, we explored the main sources of sampling or analytical bias common in observer and other monitoring programs and the methods that we can employ to minimize them.

Oral Presentations - Extended Abstracts

Is it always safe to assume normality when deriving the confidence limits for bycatch estimates?

Yong-Woo Lee

Northwest Fisheries Science Center

National Marine Fisheries Service, NOAA, U.S.A.

Introduction

Fisheries bycatch data collected by onboard scientific observers from commercial fishing fleets are a critical source of information for bycatch estimation in many fisheries across the globe. When such data are available, a ratio estimator approach is commonly used to estimate the bycatch ratios and, hence the total bycatch amounts of fish species. Bycatch data are often collected with a stratified design, or post-stratified for estimation purposes. A stratum is defined by a combination of temporal, spatial, and fishing-related factors (e.g., fishery sector, gear, latitude, depth, year, or season). The bycatch ratio of a species per given stratum is simply defined as the amount of bycatch of the species divided by the fishing effort. The estimated bycatch ratio is then expanded by the total fishing effort for the given stratum to estimate the total bycatch amount within the stratum. Retained amounts of target species or species groups from landing receipts are often used as a proxy of fishing effort in bycatch estimation, because they provide a verifiable measure with high accuracy.

The variance, as a measure of uncertainty, for the point estimate of a bycatch ratio is generally estimated based on a large-sample variance approximation. The estimated variance is then used to construct the conventional symmetric confidence limits around the ratio with an asymptotic normality assumption, and hence around total bycatch estimates. However, because observer sampling coverage is sometimes low (< 10%), an asymptotic

normality assumption for confidence limits should be evaluated over varying levels of observer coverage.

Another consideration regarding the normality assumption should be given in terms of the different encounter rates of the species when evaluating the normality assumption for the confidence limits. Encounter rates differ by species, due to such factors as current abundance, distributional patterns, gear avoidance, gear selection, etc. Some species are encountered much more rarely than other species. Despite the vast differences in the encounter rates by species, the same large-sample variance approximation formula is often applied across all species to estimate the variance, and hence confidence limits, with an assumption of normality.

Since 2011, the groundfish fishery on the U.S. West Coast has operated under a new management system, often referred to as Catch Shares. Under this system, fishing vessels in the federally regulated fishery must be accompanied by at least one at-sea observer onboard during all fishing trips (i.e., 100% observer coverage). Observers sample the amount of discarded bycatch by species, along with conducting other sampling duties. This type of 100% observed fishery data provides a unique opportunity to empirically evaluate the validity of confidence limits constructed with a normality assumption, because true population parameters are known to the investigators.

Materials and Methods

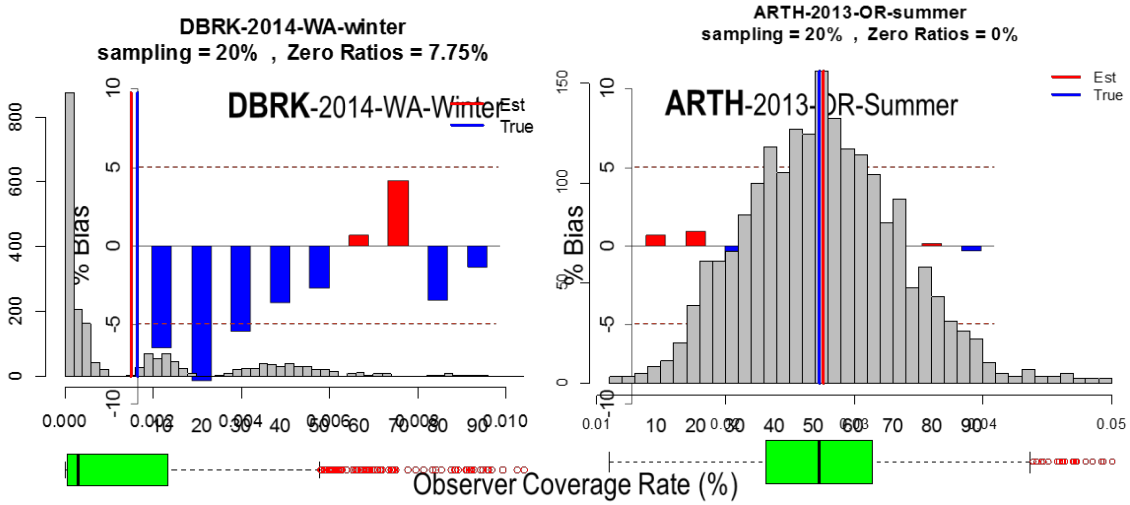
Four years of observer data (2011–2014) from the bottom trawl Catch Shares fishery on the U.S. West Coast were used for the study, which had 100% observer coverage (i.e., census data). The data were stratified by year, state, and season. A bootstrap resampling technique was used to simulate the bycatch observations for several groundfish species that were selected based on their bycatch levels (high vs. low). To simulate the varying levels of observer coverage within a given stratum, the data with 100% observation were randomly subsampled at a predetermined observer coverage rate. The coverage rates were set from 10% to 90%, with a 10% interval. The bycatch ratios of the selected species were estimated and stored for each coverage level per stratum. This procedure of data resampling and bycatch estimation was repeated 2,000 times, which resulted in 2,000 bycatch ratio estimates for each species per stratum at a given coverage rate. These estimated bycatch ratios from the resamples were then examined for accuracy and distributional features over the range of coverage rates.

Results and Discussion

The results indicate that the relative bias in bycatch estimation became quickly negligible in most cases when the observer coverage level was more than 20%, although the level of relative bias could be concerning for rarely encountered species at lower coverage levels (Fig. 1).

Figure 1. Relative bias (%) of the bycatch ratio estimates over the range of different observer coverage levels for darkblotched rockfish (DBRK) in the stratum of Washington State during the winter season of 2014, and for arrowtooth flounder (ARTH) in the stratum of Oregon State during the summer season of 2013. DBRK is a rarely encountered species and ARTH is a commonly encountered species.

It was evident that the distributions of bycatch estimates were often highly skewed to the right at lower coverage rates (< 30%; Fig. 2). For the rarely encountered species, such as darkblotched rockfish, the skew was much more pronounced, and multimodal patterns were also present at lower coverage rates. Skewness did not improve until coverage rates became as high as 70% in some cases of rarely encountered species. The multimodal patterns in the distribution of the estimates for the rarely encountered species appeared to be caused by the large number of hauls with no encounters (i.e., zeros in the data set). It was also noted that rarely encountered species had high chances of having bycatch ratios estimated to be zero when observer coverage rates were low, even though the true ratio was positive. In other words, with low observer coverage rates, there is a greater chance to



produce false estimates of "zero bycatch" for rare species, even if the true bycatch is not zero.

Figure 2. Histograms of bycatch ratio estimates out of 2,000 resampled realizations at the sampling coverage rate of 20%. The vertical color lines indicate the average of the estimated ratios (red) and the true ratio (blue). To illustrate the contrast, two species with different levels of bycatch (low vs. high) were selected for graph presentation: darkblotched rockfish (DBRK) in the stratum of Washington State during the winter season of 2014, and arrowtooth flounder (ARTH) in the stratum of Oregon State during the summer season of

2013. It should be noted that the chance of falsely estimating the bycatch ratio to be zero was about 8% for DBRK, whereas it was 0% for ARTH at the coverage rate of 20%.

In addition, the bycatch ratios for rarely encountered species tend to be very small numbers (i.e., close to zero), with a relatively large variance because of sporadic encounters. If the confidence limits (CLs) are constructed based on an asymptotic normality for those rarely encountered species, the lower CLs are often estimated to be negative at low observer coverages, because of the symmetry of the assumed normality distribution around the point estimate. Negative values are not unrealistic for ratios and their confidence limits.

Given these findings, a bootstrap- or resampling-based estimation method would be recommended as a preferred method when constructing confidence limits for the bycatch estimates of rare-encounter species, rather than blindly relying on an asymptotic normality assumption. This is particularly true if the bycatch information needed is focused on a very few specific protected species for conservation or management matters, as those species tend to be more rarely encountered due to their low abundance.

Evaluating the effects of observer sampling on estimates of fishing mortality in a U.S. Pacific groundfish fishery

Jason E. Jannot, M. Bellman, J. McVeigh, K. Somers, Y.-W. Lee

NWFSC, NMFS, NOAA, Seattle, WA

Introduction

A precise and complete accounting of fisheries mortality is necessary to: 1) prevent overfishing of target species; 2) prevent endangerment to threatened species and; 3) understand the impact of fishing on all ocean species. Total fishing mortality estimates includes two portions: (1) individuals discarded at sea (either target or non-target) and (2) individuals landed at the dock. Estimates of landed catch are often assumed to be relatively precise and accurate whereas, discard estimates tend to be more uncertain than landed catch estimates.

The percentage of fishing vessels monitored by observers (a.k.a., coverage), determines the amount of fishery dependent sampling and thus, the precision of discard estimates. The amount of observer coverage required to obtain precise discard mortality estimates will vary by fishery and species making it challenging to *a priori* estimate the coverage needed for a particular fishery. Estimates of the necessary observer coverage to meet precision goals are rare and, to our knowledge, none have had the advantage of studying the problem when a complete census of discards has been taken.

How much observer coverage is necessary to meet scientific data collection goals and precision standards? What is the relationship between observer coverage, estimates of discard mortality and precision surrounding discard estimates? How do these relationships vary by species or species-groups? To answer these questions we analyzed the relationship between observer coverage, discard mortality, and precision for a suite of species or species

groups in the US west coast IFQ groundfish fishery. We predicted that, at relatively low coverage rates discard estimates would converge near true discard amounts and that increasing coverage rates would decrease uncertainty around these estimates.

Material and Methods

We exploited a recent shift in observer coverage from an average of 19% during the period 2002-10 to 100% mandatory observer coverage (2011-2011) in the multi-species US Pacific west coast bottom trawl groundfish fishery that operates between the US-Canadian and U.S-Mexican borders. In January 2011, an IFQ system was implemented in the fishery, requiring 100% observer coverage of all fishing trips. We examined the available observer data from the 100% coverage period (2011-2013) to help answer these questions.

We used non-parametric resampling to sample vessels, without replacement, 2000 times from the 100% observed IFQ fishery, at simulated target coverage rates from 0.05-0.95 at 0.05 intervals. For each draw, we estimated fleet-wide discard and precision (CV). All trips and hauls from each draw were included in estimates. We assumed 100% mortality for all discards. We show how estimated discard and CV vary across species split into four management categories: 1) IFQ species under a rebuilding plan; 2) IFQ species not under a rebuilding plan; 3) Protected species under management (eulachon, green sturgeon, Pacific halibut, salmon); and 4) Other species or species groups of interest that are not under IFQ or protection.

Finally, we present the results of a generalized linear model that explains how median CV changes as a function of coverage rate, while controlling for discard weight. The final model (discard weight, coverage, species-group, coverage-by-species interaction) was used to predict the median CV for each species or group at each coverage level.

Results

Median estimates of precision (CV) were relatively high (> 30%) when actual discard amounts were low (< 1 mt) and then CVs exponentially declined as actual coast-wide discard amounts increased. CVs were more variable across coverage rates and across and within species than discard estimates. Half of the species or groups (20/40) had wide precision estimates at low coverage rates that exponentially declined as coverage rates increased. However, many other species (16/40) had precision estimates that declined in a more linear fashion and four species actually had an initial increase in CV with coverage before declining.

NOAA Fisheries recommends that CVs around bycatch estimates should be less than or equal to 30%. Within a realistic range of coverage (10-50%), median CVs varied widely depending on species or species group (Figure 1). The median resampled CV estimate for approximately one-third of the species in this study was never $\leq$ the 30% NMFS recommended CV for any of the 3 years, at any coverage rate. Most IFQ rebuilding and a few IFQ species had median CVs that were not below the 30% recommendation (Figure 2). Most other IFQ species, protected species and other groups had median CVs below the 30% recommendation; however, all species, regardless of type, appear to have some probability of median CVs greater than 30% (Figure 2). For the 70% of species shown in Figure 1, a coverage rate of 35-40% would be necessary to achieve a 30% or less CV for all 3 years.

Discard weight accounted for almost 49% of the variance in CV whereas species or groups accounted for nearly 27% (Table 1). Despite the significant coverage-species interaction in the model, observer coverage and the coverage-species interaction accounted for less of the variation in median CV than discard weight and species (Table 1).

Discussion

There are three main messages resulting from this work, all of which pertain to observer coverage less than 100%. First, uncertainty in discard mortality around species that are rarely or infrequently caught will be much greater than uncertainty around species commonly found in the catch. Managing threatened or endangered species, including rebuilding species, with low total population numbers that are rarely caught will require taking into account the greater uncertainty around discard estimates of these species. Second, the precision estimates are very sensitive to differences among species and the amount of discard. Surprisingly, even though observer coverage rate did significantly predict CV, its overall effect (i.e., explained variation) was low compared to discard weight and varied by species. The implication here is that altering coverage rate might have little overall effect on reducing scientific uncertainty and any effect realized by a change in coverage will be species specific. Third, this fishery appears to hit diminishing returns at a coverage rate of 0.4. At this level of coverage, only ~70% of the species actually had CVs less than the recommended 30%. The other 30% of species (mostly, IFQ rebuilding) in this study, uncertainty remained above the recommended level even when coverage rates were above 0.4. For these species, there is no reasonable coverage rate that will bring uncertainty below the 30% NMFS recommendation. Management will need to account for the increased risk of overfishing or endangerment of these species by adjusting harvest control rules to account for monitoring uncertainty if observer coverage goes below the current 100% mandate. Given the small effect of coverage on CVs, additional coverage (observer or EM) is not likely to dramatically increase precision of these estimates and thus increasing coverage might not be cost effective.

Given these caveats, we recommend that CV be used in combination with other factors to understand and estimate needed observer coverage. For example, observer programs should focus on ensuring selection is unbiased, that observer coverage is appropriately distributed in both space and time.

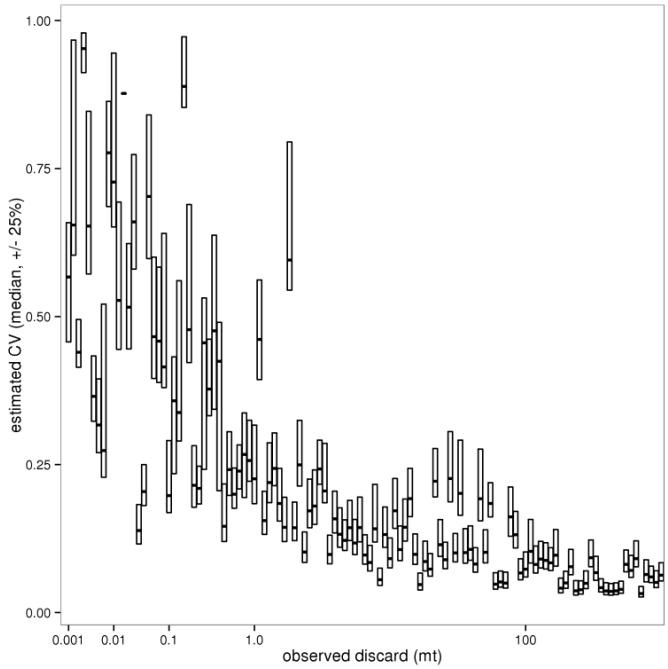


Figure 1. Estimated CV (median ± 25%) as a function of total observed discard. Each bar represents a species-year combination (2011-2013).

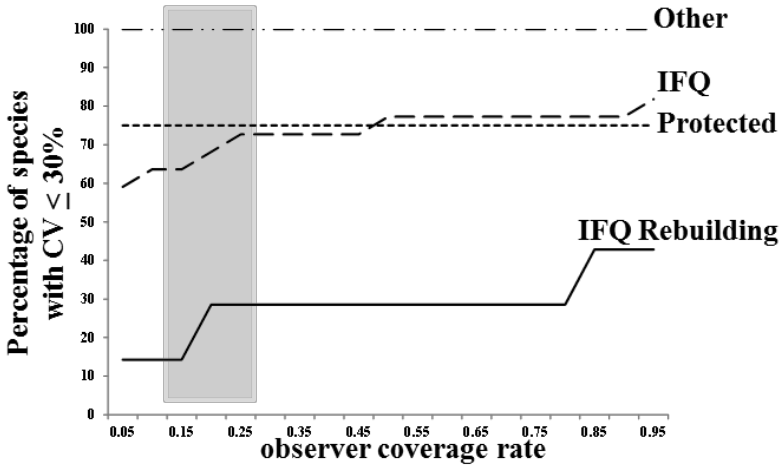


Figure 2. Percentage of species within each management category with a predicted median CV of ≤ 30% as a function of the proportion of observer coverage. Grey box represents historical observer coverage range for the fishery (2002-10). Predictions of median CV were obtained from the general linear model, holding the discard weight at the median observed (actual) weight for the 2011-13 period.

The EU landing obligation and its impact on discard data

Lisa Borges

FishFix, Brussels, Belgium

Keywords: discard ban, management policy, European fisheries

Introduction

The recent reform of the Common Fisheries Policy (CFP) of the European Union (EU) introduced a Landing Obligation (LO) for all EU fishing vessels for certain species and fisheries starting from 2015. Its introduction is one of the most significant reform elements in the new CFP, and represents a fundamental shift in the management approach to EU fisheries. Its primary objective is to reduce unwanted catch (European Union, 2013), while at the same time to promote sustainable fisheries by reducing fishing mortality of animals of low commercial value sizes and species.

The LO is only applicable to total allowable catch (TAC)-regulated species in the Atlantic and to species that have a minimum landing size (MLS) in the Mediterranean Sea, caught in European waters or by European fishing vessels. It is being implemented progressively by species and fisheries, starting with pelagic fisheries and fisheries in the Baltic Sea in 2015, to be completed by 2019 (European Union, 2013).

if the LO is fully implemented (i.e., is monitored at sea at significantly high levels) it will reduce unwanted catch in the first place since fishing operations will change to maximize the use of the space on board vessels and quota available for high value species and sizes. At the same time it will drive improvements in gear selectivity to reduce the catch of undesirable species and sizes. It will increase discard knowledge as monitoring of fishing operations will be increased from present low levels. And finally, it will safeguard stock recovery by protecting strong year classes of stocks under severe fishing pressure, by improving selectivity and/or closing the fishery when the quota has been reached (Borges, 2015).

Results & Discussion

But one year on what has changed? In 2015 the EU landing obligation was only applicable to TAC regulated species caught by pelagic fisheries and fisheries in the Baltic Sea. Most importantly, enforcement of the LO was postponed to 2017 in order to give fishers time to adjust their operations (European Union, 2015). Three possible exemptions were also granted: species for which fishing is prohibited, species that have high survival rates after being discarded, and catches falling under the *de minimis* exemption (difficulties in increasing selectivity or disproportionate costs of handling unwanted catches).

It seems that fishing operations in the European Union have not changed significantly after one year of the LO. In some fisheries unwanted catch was simply reduced by setting the Minimum Conservation Reference Size (MCRS) below the previous MLS (Borges, 2016). But more importantly there was a refusal to let observers on board fishing vessels that lead to discard sampling only being resumed in the last quarter of the year. Furthermore, there is a clear discrepancy between discard rates reported by scientific agencies and national administrations, while there are indications that the catch profiles between observed and unobserved vessels are different. But more worryingly there seems to be decrease of selectivity, where more small fish are being caught (ICES, 2016).

So after one year of the LO discard sampling is likely biased, not only in time but also to the vessels that did allowed observer on board. Considering that discarding is changing trough

the LO exemptions granted, there is a clear decrease of knowledge on the discarding behavior by European fleets. This will undoubtedly compromise scientific advice on catch opportunities, that have now a strong component on discards. So while landings advice in Europe is based on long term systematic port sampling schemes, discard advice is based on limited sampling programmes that are currently likely to be biased. So how reliable is scientific advice now in Europe? These issues need to be urgently addressed by scientists to ensure the quality of future advice and, of course, of the management measures that depend on this advice (Borges, 2016).

In the future, since at-sea monitoring programmes have from now on in Europe an enforcement/surveillance role, scientist need to work very hard to make sure their data is meaningful. Control and enforcement agencies need to work in collaboration with scientist to establish goals, and carry out risk assessment, of existing and future monitoring programs, in close collaboration with data users.

Acknowledgements

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Open Discussion Session

John Carlson (NOAA Fisheries Southeast Science Center) to Jason Jannot and Yong-Woo Lee

Question/comment

Is it time to abandon target observer coverage levels? In cases of clumped species, use a binomial estimator instead of a ratio estimator?

Response

Jason Jannot: 30% is a recommendation not a requirement, but should not be the sole determinant (e.g., correct for vessels, correct for distribution and actual observer coverage after vessel selection).

Yong-Woo Lee: Over time, try to make method better – 30% CV came up as an early useful guideline but cannot work for all species – it is a balancing act, depends on the fishery and if conservation or management viewpoint – bigger discussion needed (e.g., many species, tier system – common species use certain ratios).

Comment: Isaac Foster (CCAMLR): Have 100% coverage and require vessel bycatch reporting.

Petri Suuronen (FAO, Italy) to Lisa Borges and Ruben Verkempynck

Question/comment

Landing obligation? Everything went wrong – also introduced in Iceland and Norway and working well – 30+ years and they get the data – why so complicated/messy in EU?

Response

Lisa Borges: There are many differences – in EU only short time, cultural differences. Northerners follow the laws better – less species in northern waters 2–5 vs 200 species – in Norway started with one species but moved all 30 enforcement vessels to when change came about– Norway no observers at sea, all self-reported and landings – but better area to compare to would be Chile vs those northern countries – Chile and EU more similar.

Ruben Verkempynck: In Norway changes happened - it was beneficial to fishermen to change while in EU currently has higher number of fish.

Bruce Turris (Canadian Groundfish Research and Conservation Society) to Youg-Woo Lee and Lisa Borges

Question/comment

Groundfish coverage percent depends on program objectives – compliance? Fairness? Different levels acceptable coverage – in comparing 100% coverage with observer data. What about "observer effect"? How to account for it?

Response

Youg-Woo Lee: This is a hot potato topic – proposals to investigate this (twice) were not selected. Maybe need better proposals? But definitely need more investigation – anytime

less than 100% coverage, always uncertainty other biases can exist too, but their model assumes no bias in actual data.

Lisa Borges: During my dissertation, answered that observer effect was negligible but now with landing obligation, TAC increased, but there are no controls.

Bruce Turris: Fishermen will not report if against quota.

Youg-Woo Lee: Suggestion to use 30% above mean instead of mean to reflect true data but industry would be angry – would need more information from/about vessels.

Steve Kennelly (IC Independent Consulting) to Youg-Woo Lee

Question/comment

What about side about bias negative and positive values correct?

Response

Youg-Woo Lee: Yes, it is up and down, but all within an acceptable range.

Andrew France (Ministry for Primary Industries) to Jason Jannot, Ruben Verkempynck and Lisa Borges

Question/comment

How do you define 100% observer coverage? Large boat fishes 24/7 but the observer only works 12 hours? Have you considered 100%? How defined? Do they define it? And when observers on vessels, how do you account for priorities that take away from discards?

Response

Jason Jannot: They must hold discards until observer samples, even if dealing with incidental take first.

Ruben Verkempynck: Would define 100% as all discards sampled and all fishing behavior accounted for.

Lisa Borges: 100% should be on trips –would define 100% as all trips covered because statistically the variation occurs in between trips mostly, not hauls, etc.

Ernesto Altamirano (Inter-American Tropical Tuna Commission) to Jason Jannot

Question/comment

Purse seine has 100% coverage on large vessels – smaller vessels also pushing for 100% coverage, driven by certification, "MSC" dolphin-safe – is certification driven coverage legitimate? How does it fit into statistically- driven observer coverage?

Response

Jason Jannot: As long as observer has independent third-party certification.

Joe Arceneaux (Pacific Islands) to Kirsten Håkansson and Jason Jannot

Question/comment

Is the panel aware of guidelines to help fledgling observer programs with coverage units – trips, sets, hauls?

Response

Kirsten Håkansson: Yes, some from ISIS reports online on sampling.

Jason Jannot: Suggest looking at the very helpful NOAA document entitled Evaluating Bycatch.

*Comment: Steve Kennelly***:** EU LO and northern countries - took 15 years to settle down.

Poster Presentations – Extended Abstracts

See What

Michelle Camara

TechSea International Inc

Overall the Alaska observer program does a good job at the ecosystem approach for their data with few biases. Observers are required to collect data on many organisms; this includes data collected on fish, mammals, birds and invertebrates. Like all good things there is room for improvement. Over my almost ten years as an observer, which is a lifetime for most observers, I have seen a trend to identify more fish and less other organisms, like invertebrates, mammals and birds. The Alaska observer program and many observers are so concentrated on the fish aspect of the data that they down play the importance of other organisms. I want to discuss the way birds, mammals, invertebrates and plants are made less significant by both the program and the observers.

Birds seem to be seen as less important than the fish by many observers. I have heard many times that they did not look for short-tailed albatrosses because they did not want to write it up. I have also heard them say “Why should I care about the dead birds, they are too much work.”, “I hate birds” and my favorite “I’m a fish observer not a bird observer”. I realize that as observers we do a lot in each day and the forms are built for a single sighting yet many birds seem to follow a vessel for days within a trip. The form would be made better by putting haul to haul/day to day where the bird was sighted. No one would want to fill out the form for 10 days 3 hauls per day when it is the same bird or birds. I have worked with many observers in my ten years but most of them are not interested in the birds we see. I have told my partners hey there is a type of bird around the vessel; most ask me what it looks like. I will describe the bird and they will see it but do not seem interested. I had a partner tell me I see all the cool things. I told her it was because I look for them. I have spent on average 2 hours a day during my contracts watching seabirds how they act and move. Now I can separate a shearwater from a fulmar just by its flight and silhouette. But most

observers I have worked with can't separate them on the water. I tell my partners we are constantly doing highlights (a kids magazine to differentiate similar objects). When I started I was looking for different birds and realized that the differences are in shape and size (the obvious) and flight and movements (which are sometimes less obvious).

The observer program only wants data on a bird if It died as a result of the vessel, It is a short-tailed albatross, red legged kittiwake or any other species of concern, and if there was bird storm. I have asked if they want data on land birds that land on the vessel at sea and have been told no we do not deal with land birds. I have taken pictures of seabirds that landed on the vessel and noted it in my logbook and asked debriefers do they want the pictures and are told "no that it was not an interaction since they landed on the vessel". I have also mentioned that in our guide "Beached bird guide" they should put a live picture and flight silhouette in it so that observers could identify the live birds better and have been told that observers are to identify the birds that come up in the gear. Some of the bird pictures in the beached bird guide have a dead bird which is a skeleton with some feathers. How is someone supposed to identify birds if the identification manual is only for dead birds? This biases observers to only worry about the dead birds and to ignore the live birds. The program cares if fish are out of range but would never know if a bird is out of range because no data is collected on sightings. We have an error in our data if a fish is out of range by 2 km but we would not know if a bird is out of range. How would an observer know if a rare sighting would be rare for a species?

Mammals are another area that observers tend to misrepresent mostly by not filling out marine mammal sighting forms or by asking not to be notified of a marine mammal. The marine mammal sighting form is built for a single sighting and requires observers have time to collect a lot of data on each mammal and fill out soon after. Yet most mammal sightings are quick and during times that observers are working and do not have the time to get the latitudes and longitudes, sit and draw the animal with distinguishing marks and colorations. This form is usually filled out at the end of the day after many hours of other work between sighting and form completion. For observers that do this their saving grace is their camera, yet some vessels do not like observers to have them. Tell me this If you saw a sea lion at 4 am the vessel hauled two strings on in a row you get to the wheel house to write this mammal up do I remember all the data. No you will probably remember overall appearance and the general time. Before you do this you still have to process and enter data you collected on 6-9 samples. Now you have to fill out a form for a mammal you saw for 10 seconds at the beginning of my shift when it was dark and you had to sample in 3 minutes. Another way observers bias data is to tell crew not to notify them of mammals. Captains have asked me do you want me to tell you if I see a whale or other mammal. I have to admit that after a long day at the end of my contracts that I do not want to see them either. I'm tired, my body is sore and I have collected bruises and aches, half of which I do not know where they have come from, so yes the last thing I want to do is sit up a little longer and write it up. But I also find that those same interactions lift my spirits.

The Alaska program does not do a presentation on mammal identification but will have us watch the same safety videos every training. In a way I believe this biases observers to think that they are less important than other things. I agree that safety is very important and should be taught and every observer should be reminded that our job is dangerous, but to show the same videos every year and not to have a mammal talk seems to me to be self

deprecating to the mammal part of observer data. We lose interest in the same videos. Let's change the training up a little show two less of the same videos and do a presentation on identification on lesser seen organisms. Make it a point to remind observers mammal sightings are a duty we should be trying to do. Many of the large CP's have 2 observers on the vessel and they have 12 hour shifts and between samples many observer admit to taking naps. This is a prime time to look out for mammals and seabirds and fill out the forms.

Invertebrates and plants do not get represented as well as they should be. I have seen a decline of the identification of small invertebrates. The observer manual has some pages about invertebrates but the program does not push for better identification of these organisms. The first manual I worked with had ten pages of invertebrates that could be identified and coral was all one group. Now there are seven pages but two pages are for identifying coral to smaller groups. The program had a manual between this that was 3 or 4 pages on invertebrates, but they went back to a slightly more inclusive invertebrate manual. During training they do not even have someone come in and show organisms or pictures. There are presentations on birds and fish but no such presentation on invertebrates. There are no checks for the invertebrates and no set guidelines for how they are recorded. Plants are also recorded as miscellaneous. So I can have in one sample 3 pieces of kelp, a piece of line and some netting and they are all recorded as miscellaneous. There is no code for plant unidentified, so it gets recorded as the same as garbage.

Observers are just as interested in the invertebrates as the program which is minutely. Some observers I talk to tell me they just put down invert unidentified because they are not that important, others put down miscellaneous unidentified. I find it odd that every observer is asked to do injury assessments on halibut but sand flea (amphipod) are not in the manual. These very destructive invertebrate that will eat an entire cod in a day is not in the manual but we are to assess halibut and one line of that assessment states for pots and longliners "Sand fleas have penetrated the body via the eyes, fins, or anus". We are to know the halibut is sand flead but there is no sand flea in the identification manual. There are other invertebrates that externally and internally parasitize cod and halibut that are not sand fleas.

I have been doing this close to ten years and I still find things I can't identify, new birds and new mammals. For me it is a challenge and I look forward to these moments that break the monotony of everyday sampling. I hope that birds, mammals, invertebrates and plants will become more important to both observers and the programs.

Finally I am proud of all those out there doing this thankless job, we collect data from a difficult place and still make it look easy. Most of those data points, which are used for this ecosystem, are from observers, fisherman that help us and companies carrying us.

Abstracts of presentations that did not provide Extended Abstracts

Using statistical methods to improve regional catch sampling

Kirsten Håkansson[1], Marie Storr-Paulsen[1], Liz Clarke[2], Alastair Pout[2], Chun Chen[3] and Edwin van Helmond[3]

[1]Technical University of Denmark, National Institute of Aquatic Resources, Denmark [2]Marine Scotland Science, United Kingdom [3]Wageningen University, Institute for Marine Resources and Ecosystem Studies, Netherlands

During the last couple of years the focus on commercial fisheries sampling programs in the European Union (EU) has been on statistically sound sampling designs as opposed to a more ad-hoc design commonly used in many European countries. To achieve a more cost effective sampling program focus has also been changing from the present national to a more regional approach. This study is part of a pilot project financed through an European grant (MARE/2014/19), where one of the goals were to suggest a future regional sampling designs for stocks caught in the North East Atlantic.

Four economically important pelagic stocks (herring, mackerel and sprat) caught in the North East Atlantic were used in a simulation study to compare various regional sampling designs. 11 counties in the EU provided data from logbook and sales note at trip level from 2013 and 2014. To optimize the sampling designs different stratification scenarios were tested e.g. countries, port size and vessel length. The present sampling effort was kept as a starting point however in some of the scenarios redistributed according to landed weight. Different sampling effort was applied to attain the level where uncertainty was not decreasing although the level of samples increased.

One of the suggested regional designs was based on self-sampling of catches at-sea. There are great benefits of self-sampling small pelagic at-sea compared to sampling by observers on-shore. If well designed it can be a very cost effective way to sample. Further the samples can be frozen directly after the catch and thus obtained on a haul by haul basis and not on a trip level which a harbour sample most likely will be. It may be noted that control samples will be needed in addition to ensure independent data to evaluate and control biases.

The main findings in this study were that with a relatively simple stratification and present regional sampling effort it would be possible to achieve a very effective regional sampling design. This highlights the benefits of using statistical method to evaluate sampling designs before implementation.

Investigating Coverage Of On Board Sampled Trips And Bias In Fisheries Catch Data

Ana Cláudia Fernandes, Melinda Oroszlányová, Cristina Silva and Manuela Azevedo

IPMA, Portugal

Major sources of bias on onboard sampling for fish catch data collection relate to vessel selection, catch sampling and changes in fishing behavior in the presence of observers. The Portuguese on board sampling programme, included in European Union Data Collection Framework (DCF), is based on a quasi-random sampling of cooperative commercial vessels

between 12 and 40 meters long and one of our concerns is related to the low number of cooperative vessels included in the sampling frame (between 5 and 10 in the period 2012-2015), that is justified by several types of refusals. We compared vessels characteristics and fishing activities using trips from the target fleet and trips from the sampling frame with and without observers on board. Several parameters were analyzed: landings (total landings and landings of selected species), fishing regime and fishing effort (trip duration, number of fishing operations and number of fishing hours), and fleet spatial distribution. The analysis was carried out for the period 2012-2015 using data derived from logbooks, market sales, fleet register and vessel monitoring system (VMS).

Multivariate analysis indicates two groups of fishing operations within the target fleet, persistent in the analyzed period, with distinct fishing regimes, total landings and main landed species. In 2012, no differences were found between the fishing activity of the vessels of the sampling frame and the vessels from target fleet as well as no observer's effect in sampled trips. From the analysis extended to the whole period, we investigate whether our sampling frame conforms to a reference fleet.

Evaluating bias in an observer and self-sampling discard programme

Ruben Verkempynck, Chen Chun, Michiel Dammers and Edwin van Helmond

Wageningen IMARES, Noord-Holland, Netherlands

Sampling bias in selecting discards samples is an issue in self-sampling. To gain insight in variations and possible bias in sorting of discards by fishermen, a co-sampling programme has been set up in the Dutch demersal fleet since 2011. During each observer trip on a vessel in the reference fleet two sampled are sampled by the fishermen as they would during the self-sampling. This paper analyses the performance of both the observer and the self-sampling discard programme for bias.

From an unbiased estimator the variance of haul effect and fish residuals is estimated from the variance components. Results show that scientific observers overlook a number of fish species (mean=7.0, $p<0.01$). The most frequently detected species in both programmes is lemon sole and plaice. The mean lengths are compared for several target and bycatch species that are found in the samples. The length measurement of each individual fish is decomposed into grand mean, haul effect and residuals.

An unbiased estimator is used to estimate the grand mean, and variance of haul effect and fish residuals can be estimated from the variance components. Non-parametric bootstrapping method is used to estimate the mean difference of mean length and variance components. Results show that self-sampling exhibits an average of 1.2cm (95%CI 0.34-2.1cm) shorter plaice than observer samples, while for lemon sole no difference is detected (-0.1, 95%CI -0.7-0.5cm). This result suggests bias in sampling of plaice from the discards fraction. Self-sampling programme yields a smaller sampling variance of mean length than observer (0.07 vs. 0.20cm2 for plaice, 0.10 vs. 0.12cm2 for lemon sole). The estimated population variance of haul and fish are 3.10 and 11.29cm2 (plaice), 2.04 and 8.7cm2

(lemon sole). The next step is to include non-co-sampled hauls and trips and conduct a variance component analysis.

Additionally, the differences in raised discard estimates based on both the observer and self-sampling discard programme will be presented in terms of their consequences for assessment and advice.

Implementation, evaluation, and future of the automated observer deployment system used by the Northeast Fisheries Observer Program

Sarah Cierpich

NOAA/NMFS/NEFSC/FSB/Northeast Fisheries Observer Program, MA, United States

The Pre-Trip Notification System (PTNS) is used by the Northeast Fisheries Observer Program (NEFOP) to randomly assign At-Sea Monitors (ASMs) and NEFOP observers to monitor activity on commercial fishing vessels in the Northeast groundfish fleet of the United States. It uses a self-adjusting, tiered, probability-based algorithm to select vessels in order to reach the target ASM and NEFOP coverage rates.

Now in its 7th year of implementation, the PTNS has had to adapt in order to address transitions in regulatory measures, vessel selection bias, and equity of coverage. Major adjustments to the system have been made to account for multivariate coverage type exemptions and for the recent conversion of the ASM program from agency- to industry-funded on March 1, 2016. Changes have also been made to reduce possible observer assignment and vessel trip cancellation bias. Non-random elements were introduced to create greater equity of coverage between vessels.

The future of the PTNS is uncertain. There are always opportunities for improvement. Depending on upcoming management decisions, the system may need minor adjustments, or it may need to be stripped down to the basic algorithm and re-built to accommodate new, more complicated methods of trip selection.

Either way, the core of the PTNS - its algorithm - remains true to scientifically-sound random selection. The challenge moving forward is reducing external influences that may create non-random effects in trip sampling while also ensuring fair and reasonable coverage on an individual vessel level and keeping up with unpredictable and quickly-changing rules and regulations.

Session 11. Can data from the fishing industry be used to monitor fisheries compliance, seafood traceability and/or fisheries certification?

Leader: Lisa Borges

Because the fishing industry is increasingly required to prove their compliance to various fishing regulations, policies, traceability requirements and eco-labelling certification needs, this session explored examples where industry has taken the lead in monitoring their own activities for such purposes. This included how such programs are run and how the data are audited, validated and used.

Oral Presentations - Extended Abstracts

Fisheries Information Management System

David Karis

National Fisheries Authority, Papua New Guinea

The National Fisheries Authority Vessel Monitoring System was upgraded to a comprehensive web based platform known as the integrated Fisheries Information Management System(iFIMS) in 2010. iFIMS was developed "Fit for Purpose" as an integrated platform encompassing monitoring, eReporting, compliance and fisheries management tools. The database development has comprised of a series of projects since commencement, including:

- Vessel Register
- Asset Tracking System (ATS)
- VDS
- Crew Register
- MCS Live access and Photos
- Alerting Visual and Email/SMS
- e- Forms
- Electronic Vessel Register (Licensing)
- Other integration (such as with the FFA regional register)
- Port sampling
- Catch traceability
- Observer management and tracking
- FAD Tracking
- Industry Access
- Flag State Access.

These many interrelated components of the system are integrated and connected to each other. For example, the Observer Management module, includes the functional Observer booking system, but is also integrated to the Asset Tracking System (ATS), Alerting, eForms,

Catch Document Scheme (CDS), Licensing and Reporting systems. It is the power of this integration which makes iFIMS so efficient and effective for NFA PNG.

Using Technology to Improve and Verify Fisher Self-Sampling

Grant Course

SeaScope Fisheries Research Ltd.

The use of self-declared data in fisheries science and management has often been treated with suspicion. These concerns have surrounded the accuracy of the recorded data, the way the data has been collected, and whether the fishermen have introduced bias, either intentionally or accidentally. The cost of using observers or fishery officers to collect biological data or check self-declared catch data in remote locations is often prohibitive, resulting in some stocks and fisheries being excluded from monitoring. However, without reliable and trusted verification, the self-declared data are potentially limited and may be rejected by scientific communities and fisheries managers.

In 2015, SeaScope Fisheries Research completed two European Fisheries Fund (EFF) funded pilot studies as part of the wider project "Evidence Gathering in Support of Sustainable Scottish Fisheries". These were entitled, "Monitoring Fishery Catch to Assist Scientific Stock Assessments in Scottish Inshore Fisheries – a Pilot Study"; and "Identifying Catch Composition to Improve Scottish Inshore Fisheries Management using Technology to Enable Self-Reporting" – a Pilot Study. The duration of these projects was 9 months and they were combined and run simultaneously as one larger project.

The main objectives of these two projects were: -

- Install an appropriate Electronic Monitoring (EM) system aboard the selected participating vessels and use EM to verify self-reported catches.
- Train fishermen in self-sampling techniques and design and provide appropriate data recording sheets.
- Undertake sea trials to provide additional training in self-sampling, to collect control data, and to field test technical innovations. SeaScope investigated the use of radio frequency identification (RFID) tags, data storage tags, Bluetooth callipers and automated discard chutes.
- Collect data using EM technology and self-reporting to help address the issue of data deficient stocks.
- Undertake video review (10% of valid fishing trips) of collected data and carry out analysis on all sensor data.
- Provide catch estimates through video review and undertake comparisons between self–reported and video review catch estimates for verification purposes.

A total of 11 fishing vessels, distributed geographically between Leverburgh and the Isle of Whithorn, on the west coast of Scotland, participated in the trials; 9 creel vessels, 1 scallop dredger and a Nephrops trawler. All vessels were fitted with Archipelago Marine Research EM systems (a mixture of v4.5 and v5.0 units) complete with 3 digital video cameras per vessel. After some initial issues relating to radio frequency (RF) interference were addressed, the systems performed very well for the duration of the trials and data were collected from all vessels for at least 6 months each

The participating vessels undertook a total of 703 fishing trips as part of the project of which 568 provided self-reported catch data (Figure 1) of sufficient quality to evaluate the accuracy of self-sampling and data collection by EM technology.

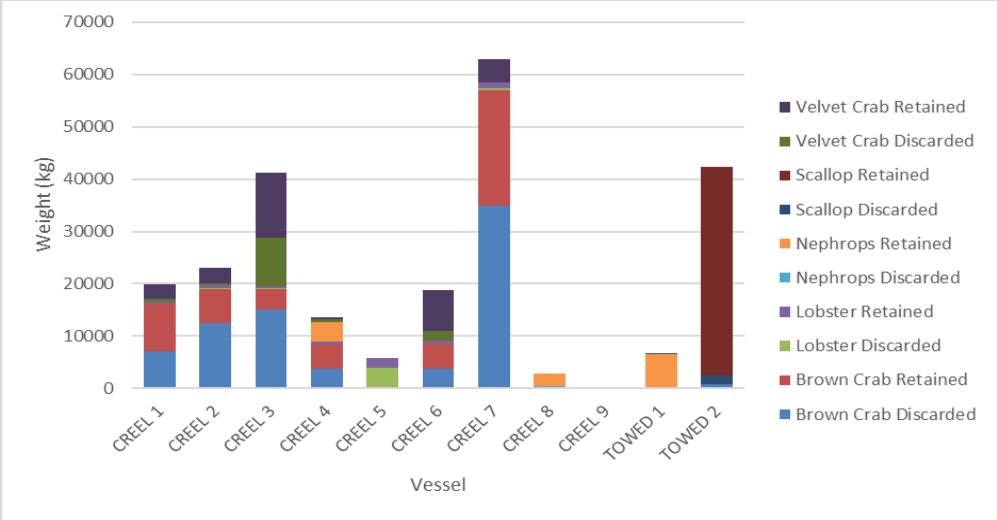

Figure 1. The self-reported catches from all valid sea trips.

In total, 85% of all fishing trips provided valid self-sampling data as usable paper records, whilst EM technology was able to collect valid usable data on 96% of all trips fished. Of these valid trips, full analysis and video review was carried out on 12% of the trips. The sensor data that was collected was reviewed at 100% of all trips undertaken, providing an excellent dataset on distribution of effort at string or haul level. Figure 2 shows a daily plot of fishing effort for one lobster creeling vessel with strings hauled marked in red.

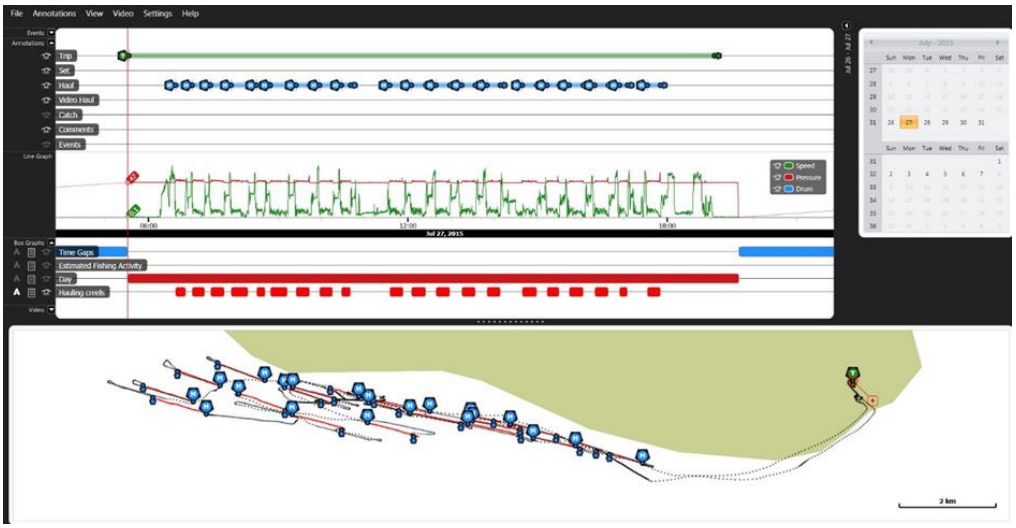

Figure 2. Screenshot from the AMR EMIPro software after the strings hauled by a creeling vessel have been identified using sensor and GPS data,

Fine-scale effort parameters (number of creels and creel soak time) can be difficult to ascertain from a 'standard' EM installation. Development of an integrated RFID system allowed these data to be collected automatically with little or no detriment to catch-handling procedures on-board. Integrating these data with catch data (determined through video analysis or self-reported data) provide CPUE data with fine scale spatial accuracy. A stand-alone data storage tag was also trialled which produced an accurate record of soak time at string level, with the added benefit of temperature at depth data.

Two separate sub-projects were trialled to address data deficiencies with fine scale biological data collection. Utilising Bluetooth callipers, fishers were able to collect length frequency data on retained target species (brown crab, lobster and velvet swimming crab) effectively and efficiently without any additional time burden as the sampling was conducted in approximately 10 minutes and whilst steaming back to port (Figure 3). To ensure that the catch was sampled randomly, one keep-pot with mixed sizes and sexes was selected for measuring. Approximately 60 individuals could be measured in 5 minutes. This mode of data collection could not only address some of the current data deficiencies but also offer significant cost savings to conventional methods of collecting shellfish length/sex data.

Figure 3. A fishermen using the Bluetooth callipers linked to a tablet, to self-record length data.

A second trial using a simulated discard chute fitted with 3 additional cameras provided footage that allowed for accurate collection of discard data. This included number by species, with accurate determination of sex for both brown crab and velvet swimming crab, and length estimations on a sub-sample of animals passing down the chute. Further refinement and development of this concept should improve its capabilities in length estimation across all species and sex determination of lobsters specifically.

Review of video data allowed 76% of the retained catch of brown crabs (by count) to be sexed, but only 32% of the discarded component of the catch. EM video review was less successful at sexing velvet crabs with only 25% sexed. Lobster proved difficult to sex from the video review due to issues with light contrasts and the need to clearly see the pleopods. Sex ratios estimated by video review were similar to those estimated by the skipper, but more rigorous on-board protocols need to be considered before these data could be used in assessments.

These trials have shown that most, if not all areas where data deficiencies exist, can potentially be supplemented with self-reported and/or data derived from EM technology. If self-reported data is to be used, then verification is necessary to remove any doubts associated with data quality. EM provides this facility. We would recommend establishing a working-group made up of fishers, researchers/scientists and managers to develop sampling schemes with realistic standardised self-sampling protocols and sampling scheme designs. We would further recommend an expanded trial over a number of years whereby a time series can be established. As these new protocols are introduced into the fishery we conclude that whilst EM can provide valuable data in itself, it is the most effective tool available at present to monitor and validate self-reported data. Further trials of innovative technology and those explored in this project, such as the Bluetooth callipers, the RFID tags and the automated discard chute, should continue to help provide additional stock assessment data.

Full project report available at www.seacopefisheries.co.uk/publications

The Landing Obligation and MSC certified fisheries

Lisa Borges[1] and Rob Blyth-Skyrme[2]

[1]FishFix, Brussels, Belgium

[2]Ichthys Marine Ecological Consulting Ltd., UK.

Keywords: discard ban, certification, European fisheries

Introduction

The recent reform of the Common Fisheries Policy (CFP) of the European Union (EU) introduced a Landing Obligation (LO) for all EU fishing vessels for certain species and fisheries starting from 2015. Its introduction is one of the most significant reform elements in the new CFP, and represents a fundamental shift in the management approach to EU fisheries. Its primary objective is to reduce unwanted catch (European Union, 2013), while at the same time to promote sustainable fisheries by reducing fishing mortality of animals of low commercial value sizes and species.

The LO is only applicable to total allowable catch (TAC)-regulated species in the Atlantic and to species that have a minimum landing size (MLS) in the Mediterranean Sea, caught in European waters or by European fishing vessels. It is being implemented progressively by species and fisheries, starting with pelagic fisheries and fisheries in the Baltic Sea in 2015, to be completed by 2019 (European Union, 2013).

No new technical measures are foreseen to specifically accompany the implementation of the LO. There are also no specific additional requirements for its monitoring and control, except for an obligation to document the catches, details of which are to be specified in multiannual plans. Failing to comply with the LO is categorized as a serious infringement under Regulation (EC) No. 1224/2009 (European Commission, 2009), but there will be a 2-year delay before sanctions take effect, i.e. from 1 January 2017 (European Union, 2015).

Many commercial stocks are moderately to highly discarded (ICES, 2015), so if the LO is fully implemented (i.e., is monitored at sea at significantly high levels) it will drive improvements in gear selectivity to reduce the catch of undesirable species and sizes, whilst it is likely that fishing operations will change to maximize the use of the space on board vessels and quota available for high value species and sizes. The LO could therefore represent the biggest push for more selective fishing in the European Union in the history of the CFP (Borges et al., 2016).

Furthermore, if the LO is fully implemented catch data quality will increase and so stock assessment uncertainty will decrease, the harvest strategy and HCR will be more robust, and evidence of compliance will be available. These factors should all lead to an increase in score (i.e., an increased chance of certification) for EU fisheries assessed against the MSC Standard. However, in undertaking this project, the authors have assumed that the LO will be implemented only weakly, with low levels of at-sea monitoring, since the LO has no

compulsory at-sea monitoring requirements, and EU Member States have yet to commit to a significant increase in monitoring, control and surveillance (MCS) programmes.

In recent years, significant efforts and various consumer-led approaches have also been attempting to drive greater sustainability and legality in European fisheries. The Marine Stewardship Council (MSC) certification scheme is one of these approaches and has achieved a high level of penetration. However, non-compliance with the LO would introduce illegality into the supply chain, which could lead to the loss of MSC certification and, with it, access to key markets. Evidence to date suggests weak LO implementation, continued discarding, and the likely degradation of catch data quality.

Methods

This study assesses how strongly the LO interacts with the MSC Standard, based on a comparison of the LO specifications with the Scoring Issues (SIs) that are used to assess fisheries within the default Version 2.0 MSC assessment tree. A review of 25 MSC certified EU fisheries (covering demersal trawl, demersal static gear and pelagic fisheries from the Baltic Sea, North Sea, North Western waters and South Western waters) was also undertaken to determine if weak implementation of the LO could lead to their future suspension or reassessment failure.

It is important to emphasize that this project has attempted to forecast what may happen with MSC certified EU fisheries in 2019 when all TAC regulated fisheries and stocks will be covered by the LO, whilst assuming weak implementation of the LO. However, faster progress with implementing the LO, evidence of widespread fishery compliance with the LO specifications, changes to the MSC Standard, or other factors could render the results invalid.

Results & Conclusions

There are strong interactions between the LO and MSC assessment tree, in particular with Performance Indicators (PIs) covering harvest strategy and compliance – PI 1.2.1 and PI 3.2.3, respectively.

Ongoing MSC certification of EU demersal trawl fisheries and EU fisheries with high discard rates is likely to be put at some risk if implementation of the LO is weak, though not meeting the MSC minimum acceptable Scoring Guidepost (SG)60 level of performance for Scoring Issues (SIs) covering harvest strategy monitoring and fishery compliance monitoring.

In the event of weak LO implementation, fisheries with already low (<10%) discard rates are considered to be at low risk of failing to meet the MSC requirements because of their intrinsic low risk of not meeting LO discarding specifications.

Although LO monitoring may have improved across the EU by 2019 when all relevant fisheries are scheduled to be subjected to the LO, the experience to date indicates that this is unlikely to be achieved at significant levels. Thus, the risk posed by the LO to almost half (6 out of 14) of the MSC-certified EU demersal trawl fisheries that were reviewed by this project is deemed high, and may lead to some of these fisheries being suspended and/or failing to achieve recertification.

Overall, the results of this project suggest that at-sea monitoring programmes will be important for the maintenance of MSC certification for many EU fisheries. These monitoring programmes provide a basis to judge if the LO, as a key component of CFP and the specific harvest strategy for individual fisheries, is being complied with.

Acknowledgements

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Credible net to plate traceability and ecolabeling in the tuna sector is possible, but at a cost: Lessons from PNA's MSC Group Chain of Custody scheme

Maurice Brownjohn OBE,

PNA Office, Majuro, RMI

What is in the claims of MSC, FAD free, free school, eco friendly, or even dolphin friendly tuna?

Consumers believe such claims are a sign of credible sustainability, they put their trust in the retailer for the validation of the claim and willingly pay premiums to help sustainability.

Whilst MSC, is considered a highly credible certifications, the level of monitoring is intense and expensive. Many competing eco claims offer similar economic returns but are clearly not based on any sustainability criteria or validation, rather "Green washing", "statements of irrelevance", or just non truths, but all play to the growing consumer consciousness and expectation, even backed by NGO pressure, the reality is the logos and claims are outgrowing the labels.

Whilst industry, brands and retailers hang their corporate image on these claims, I wonder how many boards, even know they may be party to the eco fraud of their clients.

It is only time before a class action goes from targeting can fill weights, price fixing and mis labeled of contents in the USA, to challenging the validity of the eco claims on the label.

I believe "Self certification" has a role in sectors where the consumer can readily validate the claims made, or otherwise the consequences of mis declaration are considered minor. - consider my self certified "beautiful baby" picture, You may see what I mean.!

Saying this, Self-declarations should be seen for what it is: Even if valid, without an associated and valid coc linked to absolute segregation, robust checks and balances to detect non-conformance and with independent 3rd party verification of set type from brail to the factory door, then such claims singularly, are in reality valueless. There is no such thing as "slightly Green", "slightly sustainable", probably or even "slightly eco friendly". I might add the data from observers and EM alone are also not 100% either.

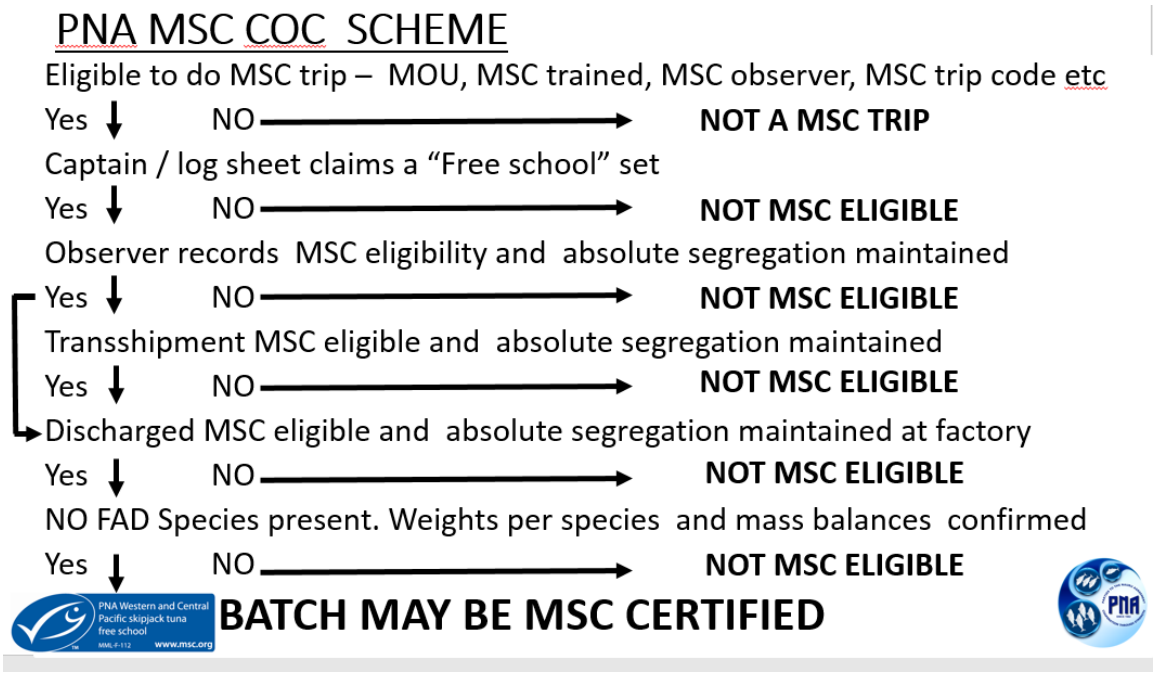
Reality is self certification schemes in the sector have facilitated laundering of non-sustainable and even IUU catches for premiums. Let us face it, who would declare their catch "unmarketable and valueless"? If this were not true, then can you tell me where to buy cheap tuna certified as "unsustainable and IUU"?

In the Pacific islands, where few other resources exist, true eco system based sustainability has driven our fishery management for thousands of years, this continues today.

PNA nations put their region's governance of Skipjack and Yellowfin up for the MSC evaluation against the global "gold" standard of sustainable fisheries in 2010, and embraced the use the MSC COC , as it allows no discretion in "eligibility". Even going as far as DNA testing in some fisheries to avoid mixing of stocks in the market.

However the PNA's, MSC free school tuna fishery is much more complex, and without precedence. A single boat can catch eligible and non eligible MSC of the same species on the same boat, on the same day, with the same gear, and almost all MSC eligible catch is subject to transshipment before being consider for MSC certification upon landing.

The PNA COC scheme draws on various sources of data as a progressive filter from the net to the factory door where the factory's MSC coc takes over and only then may the batch be considered MSC certified. Until that point, the catch of skipjack or Yellowfin free school is only MSC eligible [NOT MSC CERTIFIED.]



A few key points on the PNA COC scheme:

- Whilst PNA own the MSC certificate, they don't own the vessel or catch, so zero self certification, or self economic drive involved
- The company's data inputs eg captains log sheets are the first of many filters of eligibility in the PNA coc scheme.
- Company also provides carrier load plans and are required to follow PNA MSC COC segregation, loading and unloading requirements.
- Industry does withdraw loads where they have doubts.
- The independent 3rd party observer's data covers all points whilst at sea, transshipping , discharge and sorting on shore. At each stage it is monitored independently with reports on observations of compliance against requirements of the coc scheme and the maintenance of eligibility at each stage. Observers have no authority to downgrade.
- PNAO considers all the data from each source for progressive validation, looking especially at maintenance of absolute separation of MSC Eligible batches throughout, and especially the species and mass balance checks at the end.
- It is clear no declaration by the captain or an observer's reports can be 100% accurate, so they serve as progressive filters.
- The last check is any species that are totally FAD dependent like trigger fish, being present at any stage or even in the final out turn, this final check validates the coc and confirms no gaming of the catch during the coc.

- Only PNAO can make the final decisions to decide if MSC eligibility has been maintained, and whether the prestigious MSC certification is justified for a batch.
- The PNA COC scheme is also subject to rigorous independent audit spot and annual audits.
- Under the industry mou with PNA, the PNA Pacifical marketing arm continues to collect data for traceability through the factory, including MSC batch codes, final can codes and delivery s to the retailer.

The industry typically returns 15% premium as an incentive for the more sustainable PNA MSC free school fishing, ironically other schemes show similar returns.

Further PNA MSC is only traded with the "Pacifical" co branding, which besides being a geographic indicator, compliments the Brand, offers a unique traceability system based on the final product can code, where the consumer can trace the exact can, the factory the boat, even the captain and trip dates, whilst all the time linking the MSC product back to the peoples of the PNA nations.

Such schemes are unequal in the market, the role of observers is vital, and a comprehensive coc is critical. But such rigid schemes cost money, they are essential to ensure the credibility of the PNA MSC free school certification claims, and ultimately protect the retailer and brand to ensure the consumer genuinely gets what they pay for. Not the victim of more consumer fraud.

http://www.pacifical.com/traceability.html

Can data from the fishing industry be used to monitor fisheries compliance, seafood traceability and/or fisheries certification? Regional Observer Program in Western Indian Ocean region

Mrs Jérômine Kompé FANJANIRINA

Indian Ocean Commission, Mauritius

1. IOC PRSP mechanism

The Indian Ocean Commission (IOC) is an intergovernmental organization that includes 5 African Indian Ocean nations: Comoros, Reunion (a department of France), Madagascar, Mauritius, and Seychelles. The combined Exclusive Economic Zone (EEZ) of IOC states is very large 5.5 million km^2.

Tuna and other highly migratory species constitute the largest marine resource at the disposal of coastal countries, particularly when these are island states. The West Indian Ocean harbours important fisheries for tuna, that due to the highly migratory nature of the species, no country can monitor alone.

Therefore, in 2007, IOC member States decided to set up control mechanism namely PRSP (Regional Fisheries Surveillance Plan) funded by EU, to fight IUU fishing and to develop a coordinated strategy to improve sustainable fisheries management in the region.

Solutions found to improve fisheries catch and effort data in the IOC region include the implementation of Regional observer scheme and the sharing of Observer and MCS data. Other tools are monitor fisheries compliance, seafood traceability and fisheries certification.

2. Observer initiatives in the Western Indian Ocean region

With tuna and tuna like species catches in the Western Indian Ocean coastal countries EEZs, constituting almost 40% of total landings of large pelagic fish in the region, there is a strong need from coastal countries to improve fisheries data on catches and fishing effort in this area.

Actually, there are 4 different types of Observer programmes active in the region, that have per objective to collect fisheries data (science and control) to meet national and regional requirements (IOTC resolution 11/04):

- National Observer Program (NOP) based on national legislation and IOTC resolution 11/04 on observer scheme
- IOC Regional Observer Programme based on the regional use of existing
- IOTC Observer Program to monitor transshipment at sea – based on the resolution 14/06
- Private Observer Program implemented by Industry. Agreement with Seychelles Fishing Authority (SFA) for the deployment and coordination of observers

3. National Observer Program (NOP)

- Each IOC Member State has a National Observer Program.
- The NOPs have a national and regional legislation. The legislation mandate is provided by IOTC resolution 11/04 whereby in order to improve the collection of scientific data, at least 5% of the number of operations/sets for each gear type by the national fleet for vessel 24 meters overall length and over, and under 24 meters if they fish outside their EEZ.
- The NOP transmits observer data/reports to country fisheries management division who ensure with national prescription and compliance with RFMOs resolutions (IOTC Res.11/04) by forwarding observer data/report to the RFMO.
- It also address observation in the artisanal fisheries.

4. IOC Regional Observer Programme

- Based on the regional use of existing National Observer Programme
- In 2007, IOC countries signed an arrangement, which authorizes individual national observers to observed and collected data in the EEZs of all IOC member States. An

agreement that allows for the sharing, optimization and cooperation of national observer missions at IOC level.

- IOC provided each national observer with a nominative accreditation and an official card which allows them to observer and collected data in the EEZs of all IOC member States

- Creation in 2014 of a Working group of NOP coordinators. They meet twice a year, their role is to:

    1. Identify actions to be conducted at national and regional level
    2. Coordinate observer deployments
    3. Standardization of observer data methods and tools
    4. Exchange experiences and know-how
    5. Harmonization of observer training and management
    6. Synchronization of data collection systems used at national level.
    7. Exchange of observer data grouped by EEZ (instead of by degree square) and sharing among IOC countries

- Extension to other countries: Kenya, Mozambique and Tanzania.

5. IOTC Regional Observer programme to monitor at-sea transshipments

- This programme established in 2012 for control purposes was superseded by Resolution 14/06.

- IOTC manages the implementation of the programme.

- IOTC outsources observer deployment to a private observer provider who appoints the observers and place them on board the carrier vessels authorized to receive transshipments of fish caught in the IOTC area of competence

- The request to place an observer on a transshipment vessel is made by the flag state of the donor vessel

- The observer should not be a national of the flag State or fishing entity, nor should they be a crew member or employed by the company of one of the vessel's involve in the transshipment.

- The observer also have a compliance mandate whereby reports of possible infraction of IOTC resolutions are reported to the IOTC who then transmit to flag states

- IOTC provided to the CPCs all the copies of raw data, summaries ad reports

6. Industry Observer programme

There are multiple observer initiatives in the region implemented by the industry, such as:

- Orthongel (French) private observer programme OCUP
- Opagac and Anagac (Spain) private observer programme
- Dongwon Industries (Korea) private observer programme

- ANABAC and OPAGAG regroup all Spanish tropical tuna vessel owners. They signed a MoU with Seychelles Fishing Authority (SFA) for the 100% observer coverage of their fleet. Raw data is stocked by SFA and no data is presently shared with coastal countries or even with Spanish research institute.
- Dongwon industry is the owner of Korean flagged purse-seiners operating in the Indian Ocean. The agreement is to cover 100% of their fleet.

SFA supplies national observers to be deployed on board OPAGAC, ANABAC, Dongwon industries purse-seines, and is responsible for subsequent observer debriefing, data correction, processing and storing. SFA directly supplies IOTC with Observer Reports in the name of the Spanish and Korean fleets.

- Orthongel / OCUP (Common Unique and Permanent Observer Programme):

Orthongel regroups all French tropical tuna vessel owners. In 2013, Orthongel initiated its private fisheries observer programme, namely OCUP. This programme is implemented by the private company Océanic Développement (OD) which deploys observers from ACP countries on board French tropical tuna purse seiners operating in the Atlantic and the Indian Ocean.

OD signed a contract with SFA for the regional coordination (briefing, deployment and debriefing) of the programme in the Indian Ocean.

- Coastal countries supply national observers to be deployed in the context of OCUP. OD establishes an agreement with participating countries through the signature of a MoU or the emission of a deployment order by NOP.
- Océanic Développement is responsible for observer debriefing (by skype in the presence of SFA coordinator), data correction, processing and for reporting data to Orthongel, and forwards raw data to the French Research Institute (IRD).
- Coastal countries are supposed to have access to aggregated data collected in their EEZ through an internet tool but none of the IOC countries participating on this programme have yet access to this tool.
- The large majority of IOC countries participating to the programme haven't yet received observer reports or aggregated data concerning fishing activities conducted on their EEZ. They need the raw data collected by their observer to monitor fisheries compliance.

7. Tools used by FMC of IOC member States

The IOC countries FMC use several tools, at national and regional level, to monitor local and foreign fishing vessels licensed to operate in IOC EEZ, including:

- The monitoring of fishing vessels activities through national and regional VMS
- The reception of an entry/exit EEZ report from each vessel. Report is received 24 hrs in advance, which allows to verify if the vessel doesn't have an history of IUU activities (infraction list in StaRFISH and IUU list of RFMOs). The vessel is subject to inspections at arrival and during landing of fish (countercheck with StaRFISH entry/exit reports)
- Licence and vessel registry (StaRFISH database)
- Procedure for unloading of vessels on arrival to Port (in line with the FAO model scheme on Port State Measures to combat IUU fishing)
- Logbooks dully filled are countercheck the VMS position (national and regional), S-AIS and radar imagery in SIGMA
- Inspection of catch on board (species, tonnage, date of landing, destination) and comparison with data provided on logbook, entre/exit report and observer data (if available).
- Inspection by the Competent Authority that the fish is fit for human consumption, issue of health certificate
- Inspection of fish quality, size and other restrictions
- Authorization of unloading

8. Monitor fisheries compliance

Monitoring of compliance requires maximum information possible from different sources. IOC member states used different tools to monitor fisheries compliance.

Observer data can be used in the following:

- Verification of logbook for under reporting and/or miss reporting
- Verification with VMS data for VMS tempering
- Compliance with FADS management
- Compliance with Mitigation measures
- Compliance with regards to bycatch and discards
- In the case of IOTC observer scheme several type of infractions are detected or possible infractions are reported

This highlight not only the type of infraction but the type of fleets, countries and fishing companies that normally do not comply to national laws and IOTC resolutions

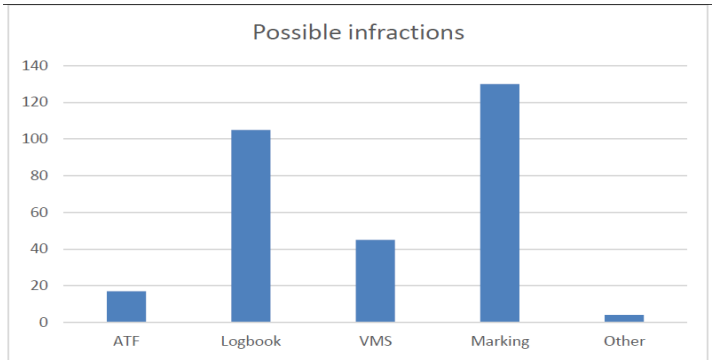


Figure 1: **Possible infractions by category under the ROP in 2015.**

9. Monitor traceability and certification

Normally validation for the purpose catch certification is done by verification of logbooks, transshipment documents and satellite tracking tool such VMS, AIS

Given the fact that observer data are more credible than logbooks, the use of observer data will strengthen the process.

Open Discussion Session

Eric Gilman (Hawaii Pacific University) to Jeromine Fanjanirina

Question/comment

My question is related to purse seine fisheries with observers industry funded programs. Do you know of any issues with bias/collection of data?

Response

Jeromine Fanjanirina: problem with these programmes is that the contractor needs to keep the raw data, so that they can send the data directly to Seychelles Fishing Authority (SFA) who has a contract with them. So the data goes directly to SFA, which also uses national observer program data. The plan is to harmonize the contracts between industry and private companies, and ask for that data.

Steve Kennelly (IC Independent Consulting) to Victor Ngcongo

Question/comment

VIMS system allows to see observer in real time, do you use this for observer safety? To monitor safety?

Response

Victor Ngcongo: Yes, in two ways. Uses in reach button, which is registered with the Hawaiian coast guard. Observers can send a message to the office to inform if something is wrong with the vessel. Also, for collecting evidence, there is a camera and voice recording in the tablet, and these can be stored. Every day, the observer sends a daily report and the officer needs to validate that report, and that states the observer is ok. Also, daily journal and all other information are stored on the tablet. The tablet is backed up every day, so if anything happens to the tablet they will still have the daily reports. Regarding text messaging: every conversation between officer and observer is recorded.

Ernesto Altamirano (Inter-American Tropical Tuna Commission) to Maurice Brownjohn

Question/comment

Noticed that data needed to certification seems to be basically the same need as any observers programme. Imagines that certification provides customer with information on good ways to harvest product, and adds value to product. Does the observer get any extra money because they are a part of the certification process? And is the observer trained differently in Papua New Guinea? It seems like they are collecting the same data.

Response

Maurice Brownjohn: PNAS developed chain of custody system based on an existing system, built on captain's logbooks. Observers training and forms used are all the same, everything is based on existing paperwork. Observers on MSC trips require however additional training. The objective is to helps them understand WHY they collect this and additional specific data. They are paid 10USD more to observe on these trips. Observers used in these programs are working in national observers programs.

Josh With (Hawaii Regional Office) to Victor Ngcongo

Question/comment

Impressed with PNG system, which is decades ahead of the Hawaiian regional office. Eforms come in and then there is debriefing process. Is this debriefing process in person? In real time? What is the process?

Response

Victor Ngcongo: Pre-debriefing happens when observers send in the daily observers report. After the trip, officer comes in and the observer is debriefed in person. Officer checks all the data with the observer. If the observer is in trouble the data can be sent in in real time. Costs 8000 USD/day. Gets to validate captain reports with observers reports.

Bubba Cook (WWF)

Question/comment

My question is related to Eric Gillman question regarding confidence in crew sampling. Dave COlpo mentioned that fishers are as smart as all of us, but they are smarter. They can cheat the system. What mechanisms do you have, to feel confident, that they will ensure the reliability of the data that comes into the system? How do you verify?

Response

Grant Course: We were not dealing with MSC certification, we just wanted to gather data. Fishers wanted to improved science. Took Archipelago model and looked at 10% of the videos compared to what was declared by fishers. Got anomalies around certain types of information, but in general found high correlation between data. Data on discards were difficult to obtain, while retained catch and effort were easy to obtain. It was however hard to figure out the length of sets.

Victor Ngcongo: In our system observers data was the only way to verify crew logbooks. They needed to ensure that whatever data is collected is able to fulfill MSC requirements. Partly to verify captains logbooks.

Maurice Brownjohn: Experience tells us that no observer system is 100% full proof, so we use all systems (video, observers on board, etc.) to get higher compliance. Some fishers are dishonest, so you have to account for this. Brian Holman commented on dolphin compliance to NOAA: if we complied, our catch would have no value.

Dennis Hansford (NOAA Fisheries) for Victor Ngcongo

Question/comment

Alluded to observers as quality assurance on data received. Slide indicated the government financed the programme until 2015. Who pays now the observers? Industry? With industry paying for observers do you feel confident that you still get quality data? Is there a perception of a conflict of interest?

Response

Victor Ngcongo: Yes, industry paid observers. The data that observers deliver is verified by a third party. WWF and other organizations verify the data for bias. MSC assessment team comes every two years to do an audit visit, and the team has to ensure there is no bias in the observer data collected. There is evidence that this programme is positive, as non-compliance is reported. Industry uses data for their own system for punishing those who do not comply. At first there was a perception of a conflict of interest. They have turned down some observer providers for this reason. Their aim was reprehensible. MoU states that they have to report on everything.

Maurice Brownjohn: In the pacific region, observers programs are under the national government of each country, boats do not pay observers directly.

Lisa Mitchell (APO) for David Karis

Question/comment

Do the tablets have the capacity for an observer to send an SOS, and what is the protocol if you do receive an SOS message?

Response

All messages go directly to service provider. If an SOS message comes up, the Hawaiian Coast Guard rescue picks it up. They locate the position where the GPS signal comes from,

and if a GPS comes from their jurisdiction, or Australian's, they contact the right people. For other areas, there is an established protocol.

Ernesto Altamirano (Inter-American Tropical Tuna Commission) to Maurice Brownjohn

Question/comment

Sees all these different dolphin safe labels, tuna free tuna label, etc. and wonder if it would not be time to think about consolidation of certifications? MSC certifies fisheries to be sustainable when they do everything correctly, observers programme is perfect, but during the fishing, if the vessel fishes in a closed area, would you consider this fish to be sustainable? In other words, if fishing complied with MSC rules, but not local ones would it still be certified sustainable? If something happens today, next audit meeting happens in 2018, so how do you make certification happen in real time?

Response

Maurice Brownjohn: The RFMO, yes, wants to see all certifications part of this program. The remaining existent certifications are fraudulent, driven by money. But I would predict future shifts to better certification schemes. PNAS runs 100% VMS on these boats, so sets do get disqualified from MSC if they were fishing outside the right area. People do not like MSC recalls, as it is bad for everyone. So it should be impossible for a boat to get near an MSC certification, when they might get a recall. MSC has a rigorous process. RFMO looks at data years later, so it is difficult to use RFMO data at audit meeting, they get to deal with data in near real time.

Victor Ngcongo: In hake fisheries, the areas fished are assessed and the gear footprint is established, and fishing can only happen there thereafter. If they leave this area fishers can lose their fishing license. Observers programme for this project is not the only source of data, but is used to verify other data.

Lisa Borges: regarding harmonization of certification labels. The European Commission tried to establish common rules for certification of sustainability, but there was no political will. At the end, the EC only revised the current labels requirements, and added more information. In the EU, we need to wait another 10 years for another policy review.

Maurice Brownjohn: about labels again, second slide with shark label. In the bottom of the slide there was a can from Europe, canned in the Indian Ocean and claimed FAO area from the south of New Zealand.

Unidentified (Pacific Community)

Question/comment

In Hawaii only experienced observers are trained in MSC certification, observers who have at least 6 trips experience. It takes around 3-4 days to do MSC training course.

Response

Ernesto Altamirano: all management measures that apply here, apply everywhere. Whole Ocean is covered.

Abstracts of presentations that did not provide Extended Abstracts

Marine Stewardship Certification of the South African Hake Trawl fishery – the development of a client-based Observer programme and data collection protocol

Victor Ngcongo

Capricorn Marine Environmental, Western Cape SA, South Africa

In 2004, the Hake Trawl fishery became the first fishery in South Africa to be certified by the Marine Stewardship Council (MSC). The certification has been renewed twice and currently remains the only certified trawl fishery in Africa. The MSC assessment relies heavily on information collected by sea-based observers that was initially provided by the state-funded observer programme, known as the Offshore Resources Observer Programme (OROP). Obtaining MSC certification requires rigorous stock assessment, ecosystem sensitivity and collaborative management. Certification resulted in the setting of conditions and the intensive collection of sea-based information. The client (South African Deep-Sea Trawling Industry Association, SADSTIA) addressed each condition through an "action plan" as required by the certification process. With the demise of OROP on recertification in 2010, SADSTIA implemented an independent observer programme in order to sustain the sea-based data collection necessary for closing out the MSC conditions. CapMarine is responsible for the observer programme and works closely with SADSTIA and the management authority (Department of Agriculture, Forestry and Fisheries, DAFF) to collect the data needed. These data include catch estimations of the target species (*Merluccius paradoxus* and *M. capensis*) to facilitate the stock assessment using a depth-base algorithm. Further, observers are trained to identify bird species, bycatch, discard species and also Endangered Threatened and Protected (ETP) species. Observer data have supported the closing out of several MSC conditions including seabird and trawl warp interactions, habitat impacts and the separation of primary and secondary bycatch species. Data collection of a high quality is vital and the programme with SADSTIA is ongoing. It is now an integral part of the MSC certification of the hake trawl sector. The development of the SADSTIA programme has also had a positive spin-off on other fishery sectors, encouraging the hake longline sector to introduce a collaborative Fishery Improvement Project (FIP) with the World Wildlife Fund (WWF). The long-term objectives of developing observer programmes in the region has had a positive influence on other African fisheries by setting a high standard in observer data collection and increasing the potential for more fisheries in the region to work towards sustainability and possibly MSC certification in the future.

Session 12. How can fisheries monitoring programs support an ecosystem based approach to fisheries management?

Leader: Eric Gilman

As agencies throughout the world implement elements of Ecosystem Based Fisheries Management (EBFM), the data requirements from fisheries monitoring programs have been substantially broadened. This session focused on the uses of observer and other monitoring data to underpin the implementation of EBFM. Topics included: accounting for total sources of catch and bycatch; analyzing species diversity, richness, productivity and susceptibility; meeting data requirements for multispecies stock assessments and defining alternative ecosystem-level reference points; monitoring ecosystem pressure, status and response indicators; monitoring broad community- and ecosystem-level effects of fishing; demonstrating adherence to the precautionary approach; and using observer data to design, refine and improve monitoring programs

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Oral Presentations - Extended Abstracts

Designing fisheries monitoring programs to support ecological data requirements for ecosystem-based fisheries management

Eric Gilman

Pelagic Ecosystems Research Group

The data requirements from fisheries monitoring programs have been substantially broadened as fisheries management authorities throughout the world transition to implementing elements of Ecosystem Based Fisheries Management (EBFM). This presentation opens the conference session, *Fisheries Monitoring to Support EBFM*, which delves into issues on uses of observer and other monitoring data to underpin the implementation of EBFM.

The presentation begins by explaining how elements of EBFM extend, rather than replacing, components of conventional fisheries management systems. We then provide five examples to demonstrate how data from fisheries observer programs underpin the implementation of elements of EBFM. Observer data enable monitoring catch, morbidity and mortality rates and levels of endangered, threatened and protected species and assessing the performance of fisheries bycatch management measures. Observer data provide a subset of the inputs needed to conduct ecological risk assessments, including semi-quantitative productivity-susceptibility analyses and quantitative model-based analyses, including multispecies and ecosystem modeling. Observer data can support estimates of some sources of unaccounted collateral fishing mortality. We conclude with recommendations for meeting EBFM data requirements. See http://tinyurl.com/data-for-EBFM for the full presentation.

1. EBFM Extends (and Doesn't Replace) Conventional Management

EBFM aims to sustain both the integrity of ecosystems and their services, balance often competing societal objectives and equitably distribute benefits, and extend (and not replace) conventional single-stock, single-fishery approaches of fisheries management systems (Table 1). Even rudimentary fisheries governance systems with limited data and resources can transition to EBFM. Some simple steps towards EBFM are inexpensive and feasible now.

For example, expanding on the first entry presented in Table 1, the EBFM extension to conventional single stock management is a multi-species harvest strategy. An ecosystem-based fisheries harvest strategy includes various elements, including ecosystem-level target and limit reference points (thresholds); harvest control rules (HCRs), which are pre-agreed actions that aim to stay near ecosystem-based targets and to not exceed ecosystem-level limits; and monitoring ecosystem pressures (including stressors from fishing), state and management response indicators, in part to inform evaluations of the performance of the HCR.

Table 1. Examples of elements of an ecosystem approach to fisheries that broaden (and do not replace) conventional fisheries management system approaches.

Conventional	EAF Extension
Single-stock harvest strategy through stock-specific reference points, harvest control rule, monitoring and evaluation	**Multispecies harvest strategy** through ecosystem reference points; harvest control rules; ecosystem pressure, state and response indicators. Manages effects of fishing on target and associated and dependent species, habitat, and broader effects (e.g., altered tropho-dynamics, size structure, diversity)
Narrow scale, single stocks of principal market species & single fisheries	**Nested scales**, all manifestations of biodiversity (populations, habitats, communities) within a defined ecosystem, and local to regional fisheries
Stock assessments for principal market species	**Multispecies and ecosystem models** to assess broad effects of management options (as well as define a system's reference state, patterns and trends in change)

2. Observer Program Data Collection to Support EBFM Extensions

2.1. *Monitor catch, injury and mortality of ETP species and assess performance of bycatch management measures*

One component of EBFM is to manage fishery effects on associated and dependent species, including endangered, threatened and protected (ETP) species. Main categories of fields collected by observers in part to monitor & manage bycatch are:

- Vessel characteristics and equipment

- Environmental parameters (e.g., sea surface temperature, Beaufort scale)
- Gear characteristics (e.g., longline hook and bait types)
- Fishing methods (e.g., purse seine set type, vessel position, date/time of operation)
- Catch (e.g., species, length, sex, longline hook number, at-vessel condition, fate, final condition)

These data fields and collection protocols enable monitoring bycatch levels, standardizing bycatch rates, determining what factors significantly explain bycatch and survival rates; and enable assessing the performance of bycatch management measures. Examples of these applications provided in the presentation include: raising observer ETP catch rates to estimate fleetwide annual catch levels; fitting observer catch data to standardized catch and survival rate models to identify factors that significantly explain catch and mortality risk; and comparing nominal and standardized ETP catch rates before and after bycatch mitigation regulations came into effect.

While findings from controlled and comparative experiments are critical to assess the capacity for efficacy and commercial viability, because crew implementation of bycatch mitigation methods that rely on crew behavior during commercial operations can differ from those during research experiments, properly designed analyses of observer data that explicitly account for potentially significant explanatory factors and covariates represent one of the only reliable methods to assess their in-practice performance.

2.2. *Conduct semi-quantitative Ecological Risk Assessments*

The most common approach for semi-quantitative ecological risk assessments (ERAs) is to use Productivity Susceptibility Analyses (PSAs). Attributes used to characterize relative susceptibility can be supplied by observer data. For example, the location of fishing grounds; depth of the fishing gear; and seasonal distribution of effort from observer data can be used to determine the degree of overlap between a species and the fishery. Information on gear designs from observer data, such as mesh size or hook size can be used to determine selectivity by species and age class. And, for example, observer data on at-vessel mortality rates (proportion of the catch that is alive vs. dead at haulback before being handled by crew) and fate of catch (retained, released alive or discarded dead) can be used to assess susceptibility.

2.3. *Conduct quantitative model-based Ecological Risk Assessments*

Multispecies and ecosystem models include those that define a system's reference state, determine patterns and trends in changes in ecosystem changes in response to pressures, including from fishing, and determine socio-ecological effects from management options. A subset of the information critical for building robust ecosystem models are supplied by observer datasets, including, for example, components of total fishing mortality, the size structure of the catch, the selectivity of fishery removals (relative catchability of functional groups), and temporal trends in mean trophic level of the catch.

2.4. *Estimate collateral sources of fishing mortality*

Explained in the previous section, reliable ecosystem models – as well as conventional single stock assessment models - require high certainty estimates of *total* fishing mortality, including from collateral, not readily detectable, sources. Collateral sources of fishing mortality include pre-catch, post-release, ghost fishing, and from cumulative and interacting indirect effects of fishing, such as when repeated sub-lethal interactions result in mortality, when released catch is displaced from habitat used for shelter, or from habitat degradation such as anoxia from discards and habitat loss caused by fishing gear. Tunas and other subsurface predators drive baitfish to the sea surface, making them available to foraging seabirds. Reduced abundance of tunas and other large pelagics due to fishing can therefore affect prey availability to seabirds.

There are sparse examples of fisheries where components of collateral mortality are routinely monitored. For example, observers in the New England trawl herring fishery estimate slipped pre-catch. Many observer programs record the disposition of organisms when returned to the sea – including degree of injury and amount of terminal tackle remaining attached, which can assist in estimating probability of post-release mortality. And in some fisheries observers record abandoned, lost and discarded fishing gear. Pre-catch losses of seabirds caught in longline and trawl fisheries have been estimated by comparing counts of bird captures during setting to the number retrieved during gear haulback.

2.5. *Monitor ecosystem pressure and state indicators & assess performance of ecosystem-level HCRs*

Observer data can be used to monitor ecosystem state indicators. For example, observer catch and length data collected by the Hawaii longline observer program enabled an assessment of changes in the relative abundance of species in different trophic levels and in the size structure of the pelagic ecosystem. So, this demonstrates the use of observer data to monitor an ecosystem trophodynamic state indicator that's sensitive to fishing pressure. And, for example, Hawaii longline seabird catch data provide an indication of ocean productivity, where higher standardized catch rates occurred during El Nino-like low ocean productivity conditions– demonstrating how observer data can be used to monitor a pelagic ecosystem state indicator.

3. Recommendations to Support Transitioning to Meet EBFM Data Requirements

Some steps towards EBFM are inexpensive and feasible now, including small changes to observer data fields and collection protocols to:

- Monitor bycatch and assess the performance of bycatch mgmt. measures (e.g., data on hook and bait type, and trends in ETP species standardized catch rates)
- Support ERAs (e.g., multispecies catch data on at-vessel survival rates)
- Increase certainty of ecosystem models (e.g., species and length catch data to estimate trends in mean trophic level of catch)
- Estimate collateral mortalities (e.g., amount of ALD fishing gear)

- Monitor ecosystem pressure and state indicators (e.g., multispecies standardized catch rates and length frequencies to estimate ecosystem size structure)

Furthermore, harmonizing observer data collection protocols would enable sharing resources for training and monitoring, and enable pooling datasets necessary to support large spatial scale analyses.

What level of monitoring is required? An ecosystem risk-based approach for identifying required levels of monitoring programs for Canadian Pacific Coast fisheries

By Katie Beach[15], Howard Stiff[16], Carole Eros[17], Dave Barrett[18]

Introduction

Canada's Department of Fisheries and Ocean (DFO) manages marine fisheries to ensure harvests are sustainable. Management decisions have historically focused on stock productivity, but since the early 2000s, DFO has increasingly considered broader ecological impacts. The need to increase understanding of these impacts was spawned by a myriad of ecosystem and economic challenges to existing management regimes. These challenges include: climate change, declining and/or more variable fish stock abundance, reduced economic viability in some fisheries, an evolving global marketplace, heightened competition for aquatic resources, and more consumer interest in ensuring the sustainability of products they consume. Moreover, international and domestic commitments compel DFO to adopt a broader ecosystem-based approach to resource management.

In its 2012 *Strategic Framework for Fishery Monitoring and Catch Reporting in the Pacific Fisheries* (The Framework), DFO Pacific Region has moved toward ecosystem-based management by basing catch monitoring standards on ecological risk. Since not all fisheries operate the same or have the same impacts, the purpose of the Framework is to provide a common understanding and approach to establishing fisheries monitoring and catch reporting standards, and to provide guidance to resource managers and harvesters on how to develop appropriate monitoring programs with specific ecological risks associated with each fishery.

This paper describes a structured risk-based analysis of the impacts of fisheries on species, stocks and habitat. Aside from basic catch data and biological sampling from the target stock, information requirements of this risk assessment include: ecological impacts on habitat and on target and non-target species (including releases of fish, seabirds, marine mammals, etc.) and encounters with species that are not captured but still impacted. The risk assessment runs through a scoring process based on the Framework to determine the

[15] Katie Beach, KTBeach Consulting
[16] Howard Stiff, Fisheries Data Systems
[17] Carole Eros, Fisheries and Oceans Canada (DFO)
[18] Dave Barrett, Pacific Monitoring and Compliance Panel

required level of monitoring and guides the development and implementation of catch monitoring programs that respond to diverse information needs and risks as required.

Process of development of risk assessment tool

The Framework is meant to ensure that monitoring programs were developed with the following principles of resource management:

1. Conservation and Sustainable Use of the resource.
2. Consistency and Transparency of the decision making process.
3. Tailored requirements.
4. Shared Accountability and Access.
5. Cost Effectiveness.

To help with implementation of the Framework, DFO enlisted the advice of the Pacific Fisheries Monitoring and Compliance Panel (M&C Panel). This M&C Panel was formed as a collaborative and inclusive forum where various interests could work towards sustainable fisheries and where cross-sectoral conversations could safely and respectively occur with respect to developing innovative solutions to on-going challenges. Participants range from community leaders from the First Nations, commercial, recreational, environmental non-government organizations (ENGOs), Fisheries and Oceans Canada (DFO) and the Province of BC as well as representatives of wider pubic concerns.

The M&C Panel contracted consultants Katie Beach and Howard Stiff to develop a risk assessment model to help standardize the application of DFO's 2012 Strategic Framework. Until now, a number of tools had been developed ad hoc to assess the ecological risks of fisheries and to guide the development of Catch Reporting and Fishery Monitoring (CR&FM) programs, but these exercises did not always compare the same variables nor did they do so equally. Furthermore, there was an obvious need for greater collaboration with industry and experts outside of the Department. As a result, DFO asked the M&C Panel to take on the development of the Risk Assessment Tool.

The Framework described the risk factors to be used (which extended beyond target species and included non-target interactions and impacts on habitat), the scale to be used to value risk (1-9) and a risk equation (consequence x likelihood).

The Risk Assessment Tool

There are six sections to the tool.

- Part A defines the fishery (e.g. gear used, timing of analysis, size and catch capability);
- Part B undertakes the ecological risk assessment;
- Part C provides an opportunity to consider resource management factors that influence decisions;

- Part D shows the calculated ecological risk scores;
- Part E shows the final risk scores, and resulting fishery monitoring target level;
- Part F provides room for notes.

To design the risk assessment tool, we used ecosystem and management factors that were identified in the *Framework.* We grouped the factors into three categories that dealt with ecosystem risks, and one that dealt with resource management variables. These categories were:

	Ecological Risks			Resource Management
	Impacts on the Main Species/Stock	Impacts on Retained and Released By-catch	Impacts on the Ecological Community and Habitat	Resource Management Considerations
Factors	1. Status of Main Species/Stock 2. Vulnerability 3. Behavioural Changes	1. Status of Retained By-Catch 2. Vulnerability of Retained By-catch 3. Status of Released By-catch 4. Vulnerability of Released By-catch	1. Impacts on key predators or prey species 2. Direct Habitat Impacts 3. Indirect Habitat Impacts	1. Type of Fishery 2. Potential to Overharvest 3. Compliance and Enforcement History 4. International and Treaty Criteria 5. Info to manage other fisheries 6. Public relations

The final risk score drives the monitoring program towards a Low, Generic, or Enhanced monitoring level. DFO then works with the user groups to design an appropriate monitoring program that addresses the areas of risk and is cost effective.

The benefits of the Risk Assessment Tool

The risk assessment tool presented here has important benefits related to transparency when implementing the 2012 Strategic Framework. These benefits include:

- Ensuring that decisions are made using consistent risk factors across all Pacific fishery assessments.
- Asking respondents to enter both a value and a rationale for the value. This provides transparency of decisions that can help fishery interests to understand why decisions are made and what risk factors are driving those decisions.
- Directing conversations between DFO and fishery interests on the ecosystem and management risks of a fishery. Through these conversations, better understanding about why decisions are made about required levels of monitoring can be established.
- The structure of the assessment allows users to see the areas of risk and particular factors that drive decisions. This can lead to tailored solutions. For instance, if a fishery has no issues with by-catch or ecological community and habitat impacts, then a FR&CM program can use a cost effective dockside monitoring program that focuses on landed catch, instead of more costly at-sea monitoring. At-sea monitoring may still occur under this example, but it can be done at a lower level and resources can instead focus on dock-side monitoring.
- Re-evaluation of a fishery is possible. This allows managers and interest groups to track how successful management measures are.

The challenges

The authors noted some challenges in designing a risk assessment model that would cover all Canadian Pacific Fisheries. The challenges include:

- Applicability across all species and fishing methods. The descriptions and examples used to explain each risk factor was especially challenging since there are numerous terms used in fisheries management throughout different fisheries in B.C.
- Applicability to complex fisheries or species. For instance, many salmon species have weak year classes when the risk may be high but an enhanced monitoring program may not be needed or cost effective for other year classes.
- Qualitative nature of assessments. Although we tried to set bounds on answer options, it is still possible that one user group may rate their fishery differently than another group.
- Display platform. The authors decided to use an Excel-based tool because almost everyone can access Excel and it is relatively easy to use. However, users must add comments for each risk rating and that does not make it easy to see or use. In the future another assessment tool may be appropriate.

For more information, see

Fisheries and Oceans Canada (DFO). 2012. Strategic Framework for Fishery Monitoring and Catch Reporting in the Pacific Fisheries.

Azores Fisheries Observer Program and COSTA Project: an example of cooperation to achieve sea turtle conservation objectives

Carla Damaso[4], Miguel Machete[1,2], Marco Santos[3], Hugo Parra[1,2], Maria Joana Cruz[4], Christopher Pham[1,2], Frederic Vandeperre[1,2]

[1]IMAR – Instituto do Mar, 9901-862 Horta, Portugal

[2]MARE – Centro de Ciências do Mar e do Ambiente, 9901-862 Horta, Portugal

[3]DRAM - Direção Regional dos Assuntos do Mar, 9900-014 Horta, Portugal

[4]OMA – Observatório do Mar dos Açores, Fábrica da Baleia de Porto Pim, 9900 Horta, Portugal

Accidental capture of juvenile loggerhead sea turtles (*Caretta caretta*) during the oceanic stage is a well recognised issue for their conservation. While great effort has been invested in protecting nesting populations on the Atlantic coast of the USA, few measures are currently in place to protect juveniles from interactions with surface longline gear.

The Azores is a Portuguese Archipelago situated in the centre of the North Atlantic with an EEZ covering almost 1 million km2 (extended continental shelf of Portugal could cover 3.9 million km2). The area is considered important for juvenile loggerheads that originate mainly from rookeries in the south eastern USA (90%) (Bolten et al. 1998, Bolker et al. 2003, Okuyama and Bolker 2005). Although available data suggest high by-catch rates (0.27/1000 hooks; Ferreira et al. 2001) in areas with high fishing effort (Mejuto et al. 2008), there is currently no abundance estimate for the region. Based on demographic, tagging and telemetry data, the residency times in the area are estimated to last several years (Bolten 2003). During this time, sea turtles show a strong association with the seamounts that are abundant in the area, probably for feeding and navigation (Santos et al. 2007).

Conservation of North Atlantic loggerhead sea turtles will necessarily need to be the object of a coordinated international effort. Yet, it is clear that the Azores will fulfil a key role in this process, because of its importance for the species, high longline fishing effort, central location and extended jurisdictional area.

Sea turtle research and conservation in the Azores started to develop strongly during the early 1980s, fruit of the collaboration of scientists from DOP/IMAR with Archie Carr, and later the Archie Carr Centre for Sea Turtle Research (ACCSTR) of the University of Florida. This collaboration, which was initially mainly restricted to the sea turtle tagging program, turned out to be instrumental in establishing and validating the “lost year” theory for North Atlantic loggerheads (Bolten et al. 1998). The collaboration later extended to other projects such as the satellite tagging of sea turtles to investigate their migratory patterns (Bolten 2003) and a five year project (2000-2004) to investigate the effect of gear modifications on the by-catch of loggerheads in the longline fishery (Bolten and Bjorndal, 2005). All this research projects resulted in an exceptional local awareness for conservation issues relating to loggerhead sea turtles and a unique involvement of the island communities. Yet, during the last decade research programs on sea turtles in the Azores gradually decreased and

awareness on issues regarding sea turtles decreased accordingly, in particular with regard to the younger generations.

The ongoing COSTA project (start in August 2015) was conceived to invert this negative tendency. Firstly, the project aimed to complement by-catch data from the longline fishery within Azorean waters. Secondly, the project aimed to restructure and consolidate long-term scientific programs, in particular the conventional tagging and sampling program. Both of these actions will support the ongoing development of a regional maritime strategy (Marine Strategy Framework Directive - MSFD, 2008/56/EC; Maritime Spatial Planning Directive – MSPD, 2014/89/EU) and are also utilized to promote awareness on sea turtle conservation issues, be it through the dissemination of best handling practises to fishermen or through the involvement of the local community and tourists in the scientific programs.

The COSTA project allowed us to successfully establish an observer program for the Portuguese surface longline fishery that is coordinated by the Azores fisheries observer program POPA (Programa de Observação das Pescas dos Açores) and is relying on a network of fishing associations, vessel owners and captains. The observers themselves are instrumental in building this network, as it strongly relies on the relationship of trust that they cultivate during their activities. Within the first year (Sep 15, 2015 – July 31, 2016) the two observers performed 375 sea days and observed 207 fishing operations (203975 hooks) onboard eight different vessels.

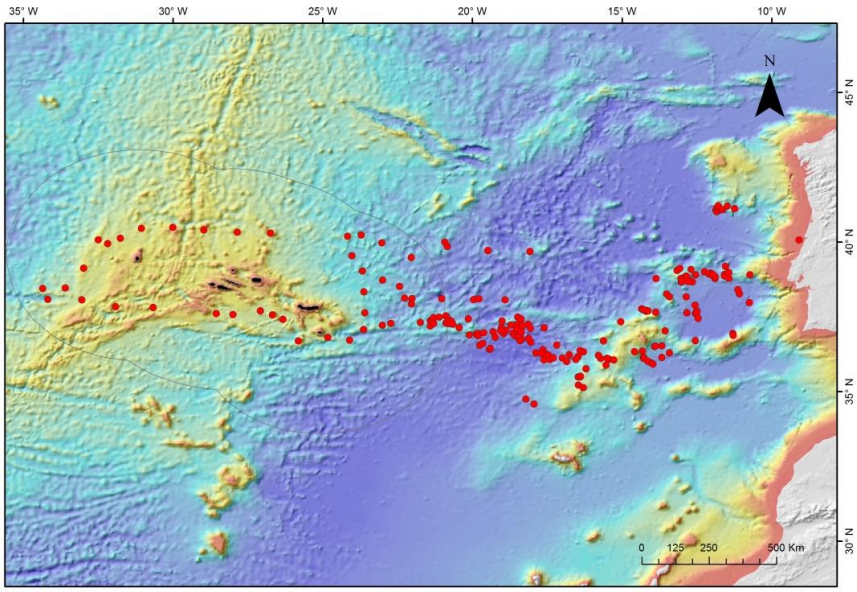

Figure 1 – Set locations of the longline fishing operations covered by COSTA observers between September 2015 and August 2016.

The spatial coverage of the observer program reflects the seasonal activity of the Portuguese fleet, and therefore covers both the area between the Iberian Peninsula and the Azores (mainly autumn-winter, 156628 hooks deployed) as well as the Azorean EEZ (mainly spring-summer, 47347 hooks deployed). Provisional by-catch rates of loggerheads within the Azores EEZ (0.04 turtles/1000 hooks) are significantly lower than previous estimates for

the area (0.27/1000 hooks; Ferreira et al. 2001). Yet, we are still striving to obtain more adequate observer coverage before drawing conclusions, because the fishing operations were largely performed during different seasons. Outside the EEZ, observed by-catch rates averaged to 0.15 turtles/1000 hooks. In addition, the observers also recorded an average by-catch rate of 0.06/1000 hooks for leatherback sea turtles. The observers further collect relevant data for conservation and resource management: 1/ catch information on target species, namely blue shark, mako shark and swordfish, which display high levels of juvenile by-catch, and 2/ catch information on species of conservation interest such as pelagic sharks (e.g. thresher sharks).

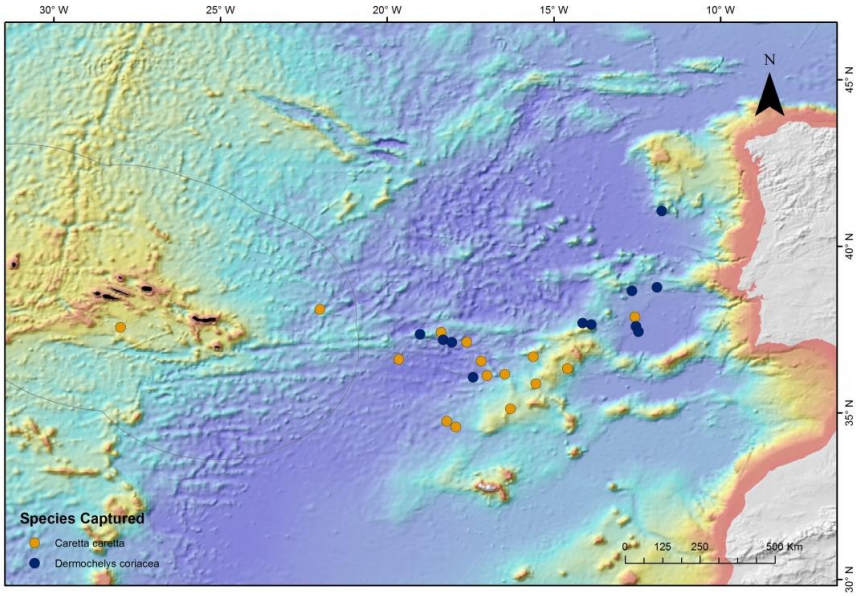

Figure 2 – Capture locations of loggerhead and leatherback sea turtles in the Portuguese longline fishery recorded by COSTA observers (period September 2015 to August 2016).

Finally, the COSTA project allowed us to develop new initiatives related to the issue of marine litter. Interaction with marine litter is, besides accidental capture in fisheries, an important threat for sea turtles, and in particular during their oceanic stage (Schuyler et al. 2014). Our observers therefore started gathering data on the distribution of floating marine litter by performing standardised transects during transit. Accurate information on this distribution will allow us to assess if the interaction in oceanic areas is related to areas of high litter accumulation, as current assessments fail to make this link (Schuyler et al. 2014).

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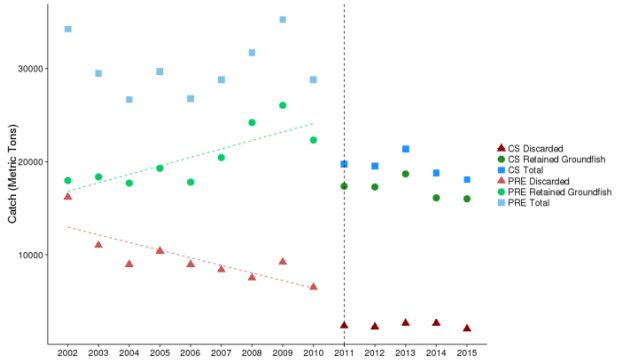
Discard Trends in a Rationalized Fishery

Kayleigh A. Somers, Jason E. Jannot, Jon T. McVeigh

NOAA Fisheries

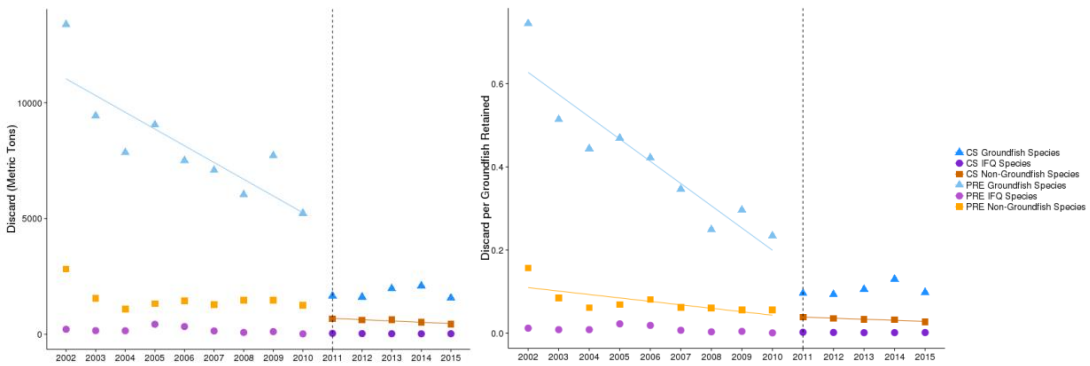
In 2011, Individual Fishing Quotas (IFQs; a catch shares [CS] program) were introduced to the U.S. west coast groundfish bottom trawl fishery. IFQs create individual accountability for landings and discards, improving economic stability for fishermen and long-term sustainability for fish stocks. CS programs should incentivize ecologically sustainable fishing practices, such as reducing discard of overfished stocks. The few studies examining the ecological sustainability of CS programs focus mainly on target and overfished stocks and ignore species outside of the formal IFQ framework, which are rarely accounted for in landings or compliance program data.



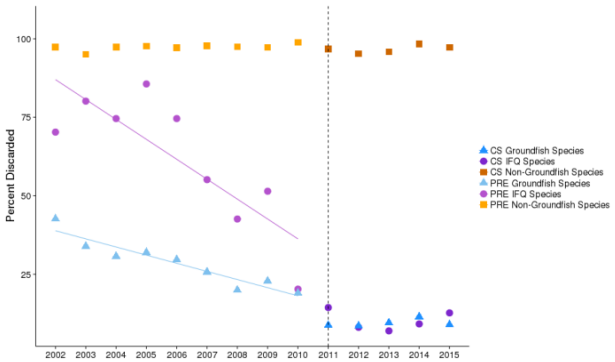
In these cases, observer data is often the only data source available to assess the impacts of a fishery at the ecosystem level. We used data from

the West Coast Groundfish Observer Program (WCGOP) to take a more holistic, ecosystem-based approach and explore how trends differ between species explicitly managed by IFQs, species managed by the Fishery Management Plan (FMP), and ecosystem component species caught but not managed within the FMP. Specifically, we asked how trends (based on linear models) and amounts (based on unpaired t-tests) for these groupings differed in terms of discard and retained amounts, rates, and proportions before and during CS management.

From 2002 to 2015, the total amount of discard and catch have shown significant, decreasing trends. Prior to CS implementation, from 2002 to 2010, retained groundfish showed an increasing trend, but no significant trend was evident during CS management or across the entire time period of 2002 to 2015. After CS implementation, the amount of discard, groundfish retained, and total catch have stabilized and do not show significant trends. Discards and total catch are at historic lows, while groundfish retained during CS management is similar to the lower range prior to CS implementation.



Total discard amounts and rates of IFQ and FMP- and non-FMP-managed species all showed significant decreasing trends from 2002 to 2015 and were significantly lower after CS implementation. FMP-managed species showed the greatest decreases, followed by non-FMP-managed species. Although statistically significant, the reduction in discard amount and rates of IFQ species was minute, likely because both variables were very low throughout 2002 to 2015.



The percent of catch discarded was significantly lower and maintained historic lows after CS implementation for both IFQ and FMP-managed species, both of which showed negative, decreasing trends from both 2002 to 2015 and 2002 to 2010. Non-FMP-managed species, however, showed no trend and 97% were both before and after CS implementation.

Species outside of the formal IFQ management framework, although not targeted, are an important part of a healthy ocean ecosystem and a high-yielding fishery. Using observer data, we are able to see the ways in which management impacts all species in the ecosystem, not just those that were targeted by regulation. These results highlight how management actions focused on a subset of species impact the discard behavior of all species encountered in a fishery, and these behavioral changes should be more explicitly incorporated into assessments of the CS program and management plans in general. With scientific data from observer programs, management can measure success beyond regulatory compliance, consider ways to better protect the ecosystem as a whole, and react quickly when a species not directly managed yesterday becomes of interest today. While CS management has reduced the percentage of IFQ species catch that are discarded, observer data shows that nearly all non-FMP species encountered continue to be discarded and highlights a potential area on which to focus future regulations. These results highlight the need to incorporate observer data in the design of additional management techniques for CS program to function within a truly ecosystem-based framework.

Using Bite Times To Adjust Longline Soak Times And Increase Efficiency While Reducing Protected Species Interactions

Matthew DUFFY

NOAA Fisheries

In order to more effectively manage the world's fish stocks, managers must begin looking at the entire ecosystem as opposed to the older method of single species management. This Ecosystem Based Fisheries Management (EBFM) provides many benefits by creating a wider perspective, including creating a more stable foundation, allowing stock that have been and are being overexploited to rebound faster, and reducing the incidental take of protected species and bycatch. The Galveston Observer Program (GOP) spearheaded a study[1] that was used to determine the optimum soak times in bottom longline targeting primarily red grouper (*Epinephelus morio*) while reducing the amount of take of protected species, such as sharks and sea turtles.

The sea turtle mortality associated with fisheries in the Gulf of Mexico (GOM) has been a contentious issue for years. Many attempts have been made to decrease the number of sea turtle interactions with the predominant fisheries, including shrimping and bottom longlining, in the GOM without interfering with the fishers' ability to make a living harvesting from the ocean. In the case of bottom longlining, measures such as seasonal closures, hook limits, decreasing fleet size and fishing depth restrictions have been implemented. While these have decreased significantly the number of interactions, there are still numerous turtles caught with longline gear. According to studies[2], sea turtle mortality increased substantially when tow times in shrimp gear exceeded 50 minutes. This, when compared to longline mean soak times of 116 minutes (NMFS, unpublished data), could be key to further decreasing sea turtle mortality in the longline fishery.

A study was performed in two separate phases to determine the average time hooks were bitten after deployment. The first phase ran from September to December of 2010 and the second phase ran from January to May of 2013. Observers were placed on vessels, and they recorded times when the timers went in the water by section, time when the timer was retrieved, as well as elapsed time on the timer. Time Depth Recorders were placed along the line to measure the time it took to sink. Capture times were calculated using recorded times using Capture Time = Time Boarded – Elapsed Time on timer – Sink Time – Section deployment time. These studies discovered a lot of valuable information regarding how selectively a longline fishes based on soak time in the first phase and soak time as well as bait type during the second phase. The research found that relatively shorter soak times were optimal for catching stationary scavengers, like grouper and snapper, while longer soak times wound up catching a higher number of migratory foragers, like sharks, and, for the purpose of this study due to their similar foraging style, turtles. In fact, after a soak of 46 minutes, over 90% of the targeted grouper were caught, and the line was almost exclusively catching only migratory foragers (sharks and turtles) after that. Fish catch rates tapered off exponentially, while shark catch rates were considerably more linear, further proving this (figure 1).

The second phase of this study also examined effects of bait type on catch rates as well as whether the fish were of legal size or not. 4 types of bait were used: herring, ladyfish head, skate and squid. The findings indicated that ladyfish head had the lowest catch rates of undersized grouper while still catching legal sized grouper, whereas skate had low CPUE on all grouper size classes, and squid caught more of both size classes (figures 2 and 3). One side effect of note is that the addition of the hook timer increased catch rates significantly when compared to a gangion without a timer (figure 4).

The data collected can easily be used by managers to implement new measures to decrease incidental take, while simultaneously increase the fishers efficiency. Shorter soak times would result in less turtles and sharks being caught, those that were caught would be released relatively quickly (optimally the longest soak time would be 46 minutes), and the fishers could set more lines, more hooks and subsequently catch more fish.

1. Foster, Daniel, Pulver, Jeffrey, Scott-Denton, Elizabeth, Bergmann, Charles, in preparation. Factors Affecting Capture Time for Species Taken in the Commercial Bottom Longline Fishery in the Eastern Gulf of Mexico.

2. Sasso, C.R. and Epperly, S.P. 2006. Seasonal sea turtle mortality risk from forced submergence in bottom trawls. Fish. Res. 81: 86–88.

Open Discussion Session

Following the seven presentations the participants and panelists discussed several issues related to how fisheries monitoring programs can meet ecological data requirements for ecosystem-based fisheries management.

The following is a summary of the main topics of discussion.

How should data fields be prioritized for collection by onboard human fisheries observers given the increasing data requirements of EBFM?

Panelist Matt Duffy provided examples from his presentation demonstrating how observer data on bait type and gear soak times can be easily collected by observers, and provide information to mitigate problematic bycatch. Panelist and session chair Eric Gilman drew on examples from his presentation, demonstrating that even relatively data-deficient fisheries with rudimentary management systems can adopt some steps towards EBFM that are inexpensive and feasible now. This includes small changes to observer data fields and collection protocols to support the various elements of EBFM, including, for example, the changes recently made by the Western and Central Pacific Fisheries Commission, a tuna regional fisheries management organization, to the pelagic longline regional observer program data collection protocols to improve monitoring bycatch.

How can outreach to fishermen support higher compliance?

The participants discussed how fishers are reluctant to change longstanding practices, despite empirical evidence from research. Outreach efforts can augment fishing community support for changes in fishing methods and gear that reduce, for example, bycatch and discards. Panelist Rodrigo Vega drew on the example he provided in his presentation on how gradually building the trust of the fishermen led to their support to increase logbook submissions and in allowing observers on their vessels. The observer program for the Chilean purse seine fishery for small pelagics has been effective in part due to the incorporation of land-based interactions between the observers and fishers – gradually building trust between them. Observers play a critical role in providing outreach to fishers – explaining how to comply with regulations. Some participants who are fishery observers shared that they are underpaidd and feel underappreciated, and desire to be viewed as biologists who relay information to fishers on the science behind the data being collected.

When changes to observer data collection fields and protocols are proposed, there is a need to account for the burden on institutions and observers.

Drawing on examples from the first presentation in the session by Eric Gilman, there are numerous examples of small changes and additions to observer program data collection fields and protocols that are a nominal burden on observers and can contribute substantially to understanding ecological effects of fisheries. However, modifying the observer data collection methods has an institutional burden that can be high, including changing observer training methods. In some cases there may be observer data collection protocols that are not useful, and should be dropped from the observer requirements. An example of how gradual changes to the Hawaii longline observer program methods for conducting seabird scan counts was referenced as an example of how observer protocols were amended over time to balance the demand on observers' time and data quality, where scan counts during setting were reduced to once at the beginning and once at the end of sets, but every hour during the haul, where during setting the observer needs time to sleep and eat.

Poster Presentations – Extended Abstracts

Modeling Community Structure and Species Co-occurrence Using Fishery Observer Data

Jeffrey R. Pulver

NOAA Fisheries, Reef Fish and Shrimp Observer Program. Galveston, TX, US.

Introduction

The incidental captures of undersized or non-target species (bycatch) are of great concern to fishery managers due to the overexploitation of stocks not only in the Gulf of Mexico (Gulf) but worldwide. Selective fishing and its consequential bycatch have a range of unintended effects such as modifying food webs and ecosystem structure, altering energy flow and species interactions, and reducing system resilience and fisheries production. The commercial Gulf reef fishery targets primarily groupers (*Epinephelus* sp. and *Mycteroperca* sp.) and snappers (*Lutjanus* sp.) using two primary gear types, bottom longline and vertical line. This fishery also has incidental bycatch for a number of species.

Analyzing fishery observer data from the Gulf deepwater reef fish fishery for community structure can provide an opportunity to examine the current quota management system that has undergone many changes in the past decade. The most recent change is a shift from a "derby" style fleet-wide quota system to an individual fishing quota (IFQ) allocation for each permit holder based on historical landings for a number of species. Managers often create quota allocations based on historical landings using logbook data[19]. By using fishery observer data that includes site-specific abundance information, more accurate representation of community structure can be derived.

Fishery managers can make better-informed decisions when determining multi-species IFQ allocation categories if patterns in species co-occurrence and stratifications in the fishery could be readily identified using fishery dependent data. The objective of this research was to compare the utility of analytical tools necessary for quantifying species relationships and revealing stratifications, if existing, for multi-species fisheries[20].

Methods

The mandatory reef fish program incorporates a randomized selection process to select federally permitted commercial reef fish vessels for observer coverage stratified by season, gear, and region[21]. To limit the scale of the study, only fishery observer data collected on

[19] Shertzer, K.W., and Williams, E.H. 2008. Fish assemblages and indicator species: reef fishes off the southeastern United States. Fishery Bulletin, 106: 257–269.

[20] Pulver, J.R., H.Liu, and E. Scott-Denton. 2016. Modelling community structure and species co-occurrence using fishery observer data. ICES Journal of Marine Science. doi:10.1093/icesjms/fsw033.

[21] Scott-Denton, E., and et al. 2011. Descriptions of the U.S. Gulf of Mexico reef fish bottom longline and vertical line fisheries based on observer data. Marine Fisheries Review, 73: 1–26.

vessels from 2006 through 2013 using bottom longline and vertical line gear from depths ≥ 100 m were included in the analyses. The deepwater grouper IFQ allocation is not for a single species but instead comprises four different grouper species: snowy grouper (*Epinephelus niveatus*), speckled hind (*Epinephelus drummondhayi*), warsaw grouper (*Epinephelus nigritus*), and yellowedge grouper (*Epinephelus flavolimbatus*). The tilefish IFQ allocation consists of three species: blueline tilefish (*Caulolatilus microps*), goldface tilefish (*Caulolatilus chrysops*), and golden tilefish (*Lopholatilus chamaeleonticeps*).

The hierarchical cluster analyses (HCA) were conducted on data sets with both gear types combined, each gear type, the most common species with ≥ 1,000 captures, and the IFQ-managed species to investigate consistent patterns in the species assemblages. Additionally, the IFQ-managed species were separated into two groups of retained and discarded, e.g., retained and discarded blueline tilefish, to analyze patterns in retention rates for each fishing set. Count data were converted to log-transformed abundance prior to HCA to reduce the influence of outliers and normalize the data. For this study, the correlation and Bray-Curtis dissimilarity measures were compared for each grouping of the analysis (Figure 1). The HCA was done using the package 'pvclust' in R with 1,000 multiscale bootstraps to create probabilities to evaluate the statistical significance in each cluster or stratification[22,23].

In addition to the HCA with multiscale bootstrapping, simulated random data were included with the actual catch data to verify species stratifications and compare methods of dissimilarity and linkage. The simulated random data used for comparisons in this study were five species with a 0.5 probability of occurrence during the fishing sets with abundance equal to the mean positive abundance for that dataset. We compared stratifications in the dendrograms using significant clusters for species stratifications with a bootstrapped probability ≥ 0.95. The significant stratifications were used to reveal patterns in covariance between the IFQ-managed species managed with multi-species deepwater quotas. By comparing these patterns in covariance with the retention rates observed, insights can be derived into fisher behavior during fishing sets.

Results/Conclusions

From 2006 through 2013, in depths ≥ 100 meters, observers recorded a total of 117,702 reef fish captures. Of these captures, 99,510 fish were recorded from vessels using bottom longline gear, and 18,192 from vertical line gear. A total of 3,194 fishing sets with captures recorded were observed for both gear types, of which 1,978 were bottom longline sets, and 1,216 were vertical line sets. A small number of species groupings dominated the catch with the 10 most abundant species accounting for > 78% of the number of captures, and the 3 most abundant comprising > 50%. Yellowedge grouper, golden tilefish, and blueline tilefish were the three most abundant species observed and were primarily captured using bottom longline gear.

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[22] R Core Team. 2015. R: a Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0.

[23] Suzuki, R., and Shimodaira, H. 2011. pvclust: Hierarchical clustering with p-values via multiscale bootstrap resampling. R package version 1.2-2.

For examining community structure with HCA, the most consistent method for filtering out the simulated random species across all subsets of the data was the correlation measure of dissimilarity with average agglomerative linkage (Figure 2). When the IFQ-managed species disposition was added for cluster analysis, previous stratifications were evident such as retained and discarded golden tilefish clustering significantly together, but not with any other IFQ-managed species (Figure 3). Blueline tilefish being kept and discarded clustered significantly with yellowedge grouper, snowy grouper, and speckled hind that were retained. Discarded yellowedge, snowy, and speckled hind grouper significantly clustered together indicating that they are not being retained during the same fishing sets.

This research is of primary interest to fisheries scientists and managers interested in deriving insights from stratifications or species co-occurrence using fishery observer data. The techniques presented are useful for determining if multi-species quota allocations could be divided into more or less distinct management units based on their stratification and co-occurrence. Using the multi-species IFQ-managed tilefish as an example, a refinement of the current allocation category into more distinct units (i.e., golden tilefish separately) may be warranted since evidence exists that this species has minimal co-occurrence with other IFQ-managed tilefish and grouper species only occurring with yellowedge grouper on some fishing sets. Figure 3 suggests the intention of fishers to selectively target golden tilefish separately from the other IFQ-managed species on fishing sets.

As an initial quantitative study on Gulf of Mexico bycatch issues, this research is an important step in advancing ecosystem-based fisheries management through our increased understanding of the complex marine environment. The statistical techniques presented in this study can be applied for analyzing fishery observer or independent data to reveal underlying stratifications and co-occurrence in other regions. These approaches provide fishery managers useful tools for visualizing community structure when proposing actions that can affect multiple species and will be highly valuable in assessing the potential impacts of regulatory mandates.

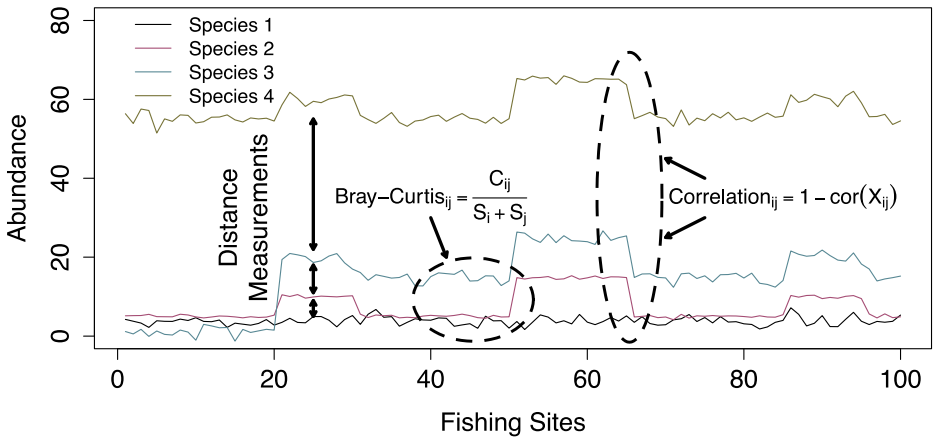

Figure 1. A hypothetical illustration of different species abundance over multiple fishing sites to compare measurement choice. Species 1-3 would be most similar using Bray-Curtis due to smaller count differences. Species 2-4 would be the most similar using correlation because of corresponding linear changes in association.

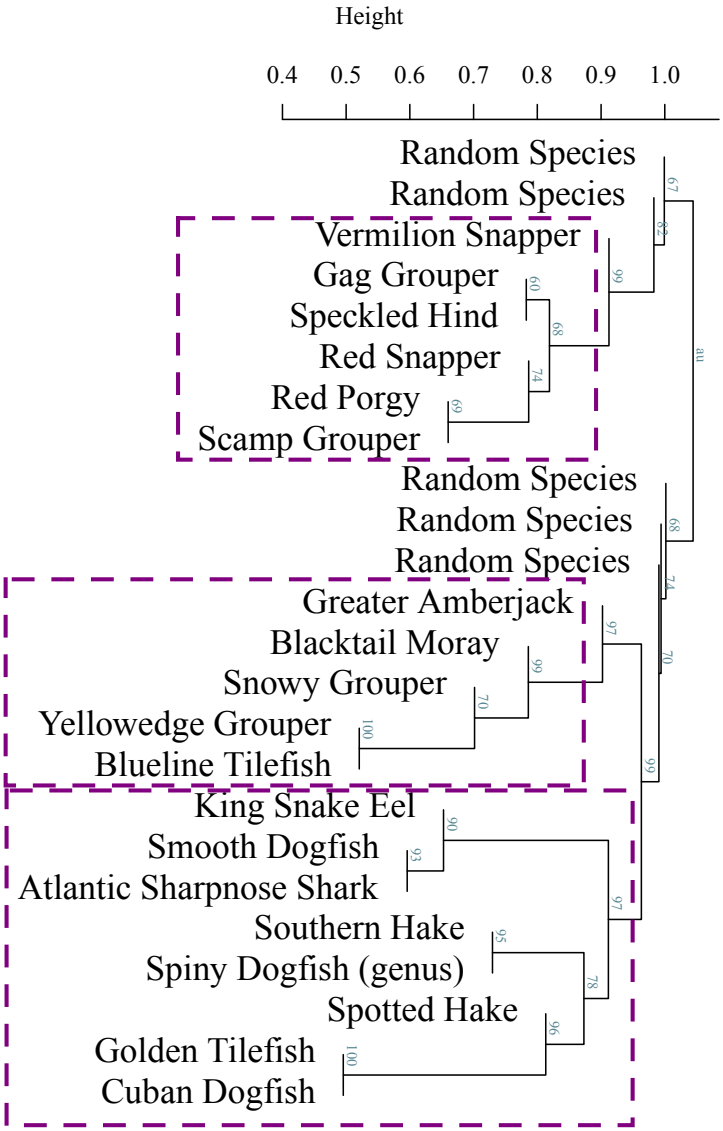

Figure 2. Dendrogram of simulated random species and species with >1,000 captures observed using the correlation measure of dissimilarity with significant stratifications.

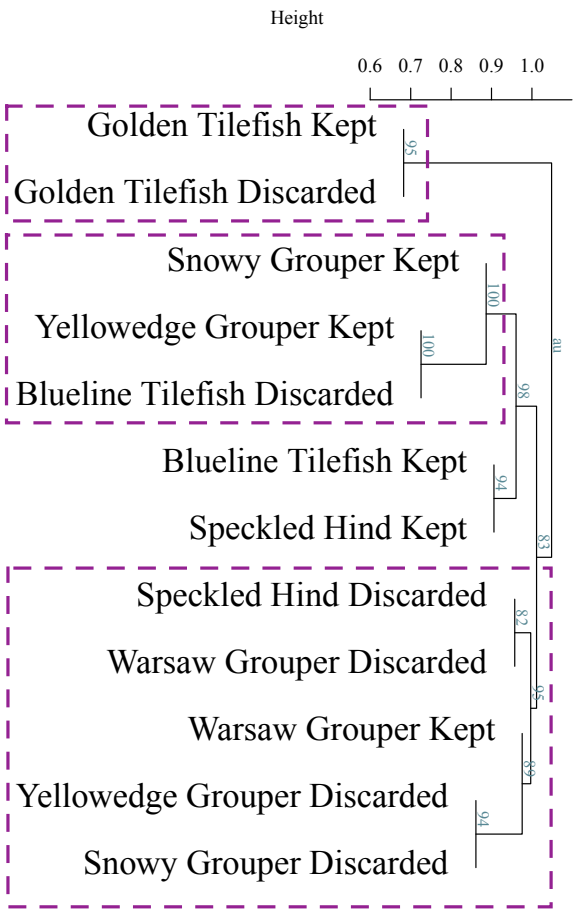

Figure 3. Dendrogram of deepwater IFQ-managed reef fish species with retention information and significant stratifications.

How can fisheries monitoring programs support an ecosystem based approach to fisheries management

S. Phillip Bear,

IAP World Services, NOAA Reef Fish and Shrimp Observer Program, Galveston, Tx, U.S.

It is unquestionable that commercial fishing operations have an impact on the ecosystem. The degree of said impacts depend on numerous factors such as fishing pressure, species targeted, bycatch, seasonal variances in species abundance and diversity, effects regarding interactions with wildlife, and impacts on the habitats themselves.

The ecological impact of the fishery would be heavily influenced by which trophic level the target and by-catch species occupy. Fisheries that target top level predators, such as tuna, billfish, sharks, etc. would have significantly different impacts from fisheries targeting forage species such as smelt, mullet, shrimps, etc. It would come as no surprise that both high and

low trophic level target fisheries would have impacts on each other. Observers monitoring low trophic targeted fisheries could identify and estimate predator numbers interacting with the fishing gear, such as fishes, sharks, birds and mammals; since species that prey upon the targeted catch would likely be in the area of fishing operations. Observers monitoring high trophic targeted fisheries could collect stomach contents of retained fishes for analysis of prey species that are being fed upon. This data could be used to determine if low trophic targeted fisheries could be affecting the prey availability to upper tier predators. While proper, accurate analysis of these stomach contents may require techniques and tools not readily available to observers in the field, the observers could at least collect stomachs or stomach contents and preserve them to be sent to labs for analysis. Observer programs could also aid in ecosystem assessment by comparing catch data from previous years to determine any shifts in populations of both targeted and bycatch species over the years.

The interactions regarding feedings on discards by predatory species would be important in several regards. A significant impact of fishing operations would be the modification of predatory behavior. It is very common for predatory species such as sharks, birds, fishes, and mammals to follow commercial fishing vessels to feed on the discards. One aspect is that the species being fed upon might not be a significant part of the predators' normal, natural diet. An example of this would the feeding of discarded grouper and snapper entrails by birds in the Gulf of Mexico. It is unlikely that these entrails would normally be a regular staple of the diet of sea birds, and many of these birds will follow a vessel to feed upon these discards for the duration of the fishing trip. It is possible that there would be physiological effects on the animals due to this shift in diet. Or for instance, species that are discarded that would not normally be predated upon could be targeted by predators after becoming accustomed to feeding upon them as bycatch discards. Another potential impact with predator interactions is the shift of the role of the predator that would normally target the sick and weak of natural prey species, to one of a scavenger feeding upon discards of commercial fishing operations. These scavenging behaviors can be passed on to offspring in birds and mammals, who often learn foraging techniques from their parents in their early stages of life. This type of behavioral shift could also impact the populations of prey species, allowing them to proliferate since some of their natural predators would have shifted their focus to scavenging of discards. The scavenging behavior could also put the wellbeing of these animals at risk by their coming into close proximity to fishing operations and increasing the risk of entanglement in gear. It would be pertinent to investigate whether the shift of predators foraging on fishing vessel discards and catches is a result of utilizing an easier source of food or a result of their normal, natural forage being depleted, with commercial fishing vessels playing the role of a competitor for available prey. Indirect feeding behaviors, such as utilizing lights of the fishing vessels to hunt prey not caught in fishing operations could also have an impact on animal behaviors. One example of such behavior is that of spotted dolphins utilizing the bright fluorescent lights on shrimp boats to hunt flying fish that fall under the lights. Observers could also note non-feeding interactions that occur. Sea birds often utilize fishing vessels as a floating resting place, although this can also be attributed to the feeding on discards. Interactive play behavior with fishing vessels, namely from marine mammals, such as bow riding and playing with fishing gear (floats, ropes, etc) that could potentially result in harm, would also be worth recording.

Observers could also focus on identifying invasive species, such as the lionfish (Pterois species) and Asian tiger shrimp (Penaeus monodon) in the Gulf of Mexico and southeast

Atlantic, to determine the spread, seasonal movements, and population dynamics of invasive species and their potential impact on fisheries and the environment. Observers could retain specimens of these invasive species for genetic studies and age/growth determination. An analysis of stomach contents and feeding habits of these invasive species could determine whether these species are actively preying upon commercially targeted species or acting as a competitor for resources with targeted species. Stomach content analysis of targeted species could also reveal potential predation opportunities of these invasive species for commercially important species.

A significant ecological impact of commercial fisheries is on the environment itself. Lost gear, snagging on structure such as corals, sponges, and oyster beds, and disturbance of the bottom substrate are among the major impacts of commercial fishing. Bottom trawlers perhaps may have the largest ecological impact on the environment. These types of fisheries can have devastating impact on benthic communities. Not only do they indiscriminately capture marine organisms, but they damage the environment by damaging or destroying the benthic substrate. Grass beds and corals are of special concern as they often serve as nursery areas for the juveniles of many species. However, there are also potential benefits of bottom trawling to the environment. Coastal areas are often subject to pollutants from runoff that can contaminate benthic communities. Benthic trawling can stir up these harmful contaminates from the bottom substrate and allow tides and currents to flush them out and dilute the pollutants. Studies could be conducted to compare and assess the health of coastal benthic communities where bottom trawling is prevalent and where it is prohibited. Analysis of the substrate could determine if these trawling activities provide a sort of cleansing benefit to the environment. A further environmental consideration is that of decomposing discards, namely from trawler fisheries. While many discards end up being consumed by scavengers, there is the potential for excess discards to remain in the environment to decompose. This would be of particular concern for inshore, enclosed waters such as sounds, bays, and estuaries where the effects would be more concentrated. It is plausible that excessive decomposing discards in these waters could contribute to detrimental effects on the ecosystem, such as toxic algae blooms and bacterial contamination. It would be pertinent to look into regulations that would reduce this potential impact on the ecosystem. Observer programs already collect data in regards to bycatch and discards. This data could be used to assess the amount of discards and predator/scavenger observations could help determine how many of these of discards are left in the environment to decompose.

Observer programs could aid in better ecosystem based fisheries management by increasing coverage on vessels that fish in areas more likely to encounter endangered or threatened species. Many of these species have seasonal abundances, such as nesting sea turtles, whale and bird migrations, etc. Some of these species also have a limited distribution range and it would be crucial to monitor these areas closely for potential interactions. The data collected could help implement regulations that could help ensure the protection of these species. These kinds of coverage strategies have been implemented by the Galveston observer program such as placing observers on skimmer trawlers to address concerns of turtle interactions and the possibility of implementing TED (turtle excluder devices) requirements in the skimmer trawl fishery.

A final and ecologically significant impact of commercial fishing operations that requires monitoring is that of pollution and discarded or lost fishing gear. Many observer programs are now increasingly required to report violations regarding pollution. Plastics are especially harmful because they remain in the environment for long periods of time may harm wildlife. Even more potentially harmful is discarded or lost fishing gear. These "ghost gears" continue to kill fish and other wildlife indiscriminately, including endangered and protected species. Observer data recording these occurrences can be compiled and used to determine the amount of debris and gear entering the environment and could reveal its potential impact. Observers could also record instances of entanglement of discarded gear from other vessels.

Using observer data to support an ecosystem based approach in CCAMLR fisheries

Isaac Forster

CCAMLR, Australia.

Introduction

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) was founded under the 1982 Convention of the same name. The CCAMLR area is extensive covering approximately 11% of the world's ocean, is remotely located in the southern ocean, and contains sensitive ecosystems that have been subjected to minimal anthropogenic disturbance. Due to the remoteness, challenging environmental conditions, and the expense of accessing the convention area, relatively few independent scientific expeditions have been undertaken and the vast majority of the marine environment remains unsurveyed.

The principles of an ecosystem based approach to fisheries are enshrined in the CCAMLR Convention text[24]. The text comprises 33 articles, drawn up as a multilateral response to concerns that unregulated increases in krill catches in the Southern Ocean could be detrimental for Antarctic marine ecosystems, particularly for seabirds, seals, whales and fish that depend on krill for food. In particular article II binds the Commission to ensure the "prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment" and the "maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources". Article IX also requires the Commission to "facilitate research into and comprehensive studies of Antarctic marine living resources and of the Antarctic marine ecosystem" and "compile data on the status of and changes in population of Antarctic marine living resources and on factors affecting the distribution, abundance and productivity of harvested species and dependent or related species or populations".

The mechanisms to achieve the objectives and principles outlined in the articles require the Commission to "formulate, adopt and revise conservation measures on the basis of the best

[24] https://www.ccamlr.org/en/organisation/camlr-convention-text

scientific evidence available". CCAMLR Conservation Measures[25] implement a comprehensive set of regulations in the categories of compliance, general fishery matters, fishery regulations and protected areas. The details of several of these conservation measures require the deployment of Scientific Observers to gather data on both the target species, and the wider marine ecosystem, and to ensure compliance with fishery regulations.

Scheme of International Scientific Observation

The CCAMLR Scheme of International Scientific Observation (SISO) was established in 1992 and comprises a series of data collection protocols for both target species and benthic bycatch, as well as the monitoring of seabird interactions with vessels and assessing vessels' mitigation measures to reduce seabird and marine mammal bycatch[26]. The data collection requirements for observers are dependent on the developmental stage of the fishery as well as the target species. For recently established fisheries that are still in the exploratory stage of development there is a requirement for two observers on board each vessel, one of whom must be appointed under the terms of SISO. For established fisheries a single international SISO observer is sufficient in finfish, crab and squid fisheries, whilst in krill fisheries there is a requirement for 50% observer coverage fleet wide. However many members also deploy domestic observers on their krill fishing vessels who voluntarily collect and submit under SISO protocols. Therefore in the past five years 92% observer coverage has been achieved in the krill fleet.

Data Collection Protocols

Currently there are three commercial fisheries operating in the CCAMLR area. These are:

- Patagonian and Antarctic Toothfish (*Dissostichus eleginoides* & *Dissostichus mawsoni*).
- Mackerel Icefish (*Champsocephalus gunnari*)
- Antarctic Krill (*Euphausia superba*)

In the toothfish fishery observers oversee a mark, recapture tagging programme to enable more accurate stock assessment, as well as periodic tagging studies on skate bycatch.

For all target species, detailed recording of length, weight, and maturity stages provides data for determining input parameters for fish stock assessment models. Sampling also takes place of representative bycatch species, and observers assist in the identification of bycatch taxa, as vessels are required to report all bycatch in their commercial catch forms. Bycatch data are used to refine specific conservation measures, which limit the amount of bycatch that can be taken on a line by line basis and total amounts of bycatch in some fisheries, and both temporary and permanent no fishing activity areas are declared due to the presence of high numbers of bycatch taxa.

Observers are also required to observe seabird and marine mammal interactions with fishing vessels, and measure and assess mitigation devices that vessels are required to

[25] https://www.ccamlr.org/en/conservation-and-management/conservation-measures
[26] https://www.ccamlr.org/en/science/ccamlr-scheme-international-scientific-observation-siso

deploy during fishing activities. Both vessels are observers are encourage to design and test mitigation devices that further reduce detrimental interactions.

Observer Contribution to Ecosystem Management Decision Making in CCAMLR

The CCAMLR Scientific Committee[27] provides the best available scientific information on ecosystem management to the Commission, which is obligated by the Convention to take full account of the recommendations and advice of the Scientific Committee. The SISO programme is a key data contributor to several of the Scientific Committee's expert working groups, along with commercial fisheries data and wider ecosystem monitoring programmes undertaken by members. The data collection protocols for SISO are reviewed annually as the data collected by observers are essential for CCAMLR's assessment of fish stocks, evaluation of fishery impacts on marine resources, and assessment on the performance of conservation measures.

Abstracts of presentations that did not provide Extended Abstracts

Interactions between Marine Mammals and Peruvian Purse Seine Fishery: Importance of the on board observers

Sofia Rivadeneyra Villafuerte[1], Gersson Roman Amancio[2] and Elisa Goya Sueyoshi[2]

[1]Instituto del Mar del Peru, Lima, Peru [2]Instituto del Mar del Peru, Peru

According to the International Union for the Conservation of Nature (IUCN), 26 of the 39 species of marine mammals registered in Peru are classified as Data Deficient (DD), which means that given the lack of information, their population status is still unknown. Since 2009 the Instituto del Mar del Peru (IMARPE) on board Programme "Programa Bitacoras de Pesca (PBP)" carries out the record of marine mammals interaction with the anchovy commercial vessels, getting valuable information about resident and migrating species, behavior of the groups involved in the interaction and age and sex of the individuals. This data contributes to the knowledge of the seasonal variability (related to reproductive seasons, environmental changes, etc.), distribution and relative abundance of marine mammals in the Peruvian coast.

By the time, the PBP counts with 40 observers who are mainly distributed along the central - northern coast, because of the size of the fleet. The information registered by the observers indicates that the most seen species is the South American Sea Lion, which occur mostly while the net is enclosing the fish and causes damage to nets and catches. By the other hand, the PBP has reported the presence of humpback whales and common dolphins foraging around the net and feeding on catches into the net. This findings helps to better

[27] https://www.ccamlr.org/en/science/scientific-committee

understand the feeding behavior of cetaceans and its patterns of distribution along the Peruvian Coast.

The on board observers provides of comparable annual data and allows to stablish levels of interaction between marine mammals and the purse seine fleet, seasonal tendencies as well as foraging patterns and its temporal and spacial changes, bringing trustworthy real time information.

Discard and bycatch research program in the Chilean pelagic purse seine fleets: A work-based approach with fishermen

Rodrigo Vega[1] and Oscar Guzman[2]

[1]Instituto de Fomento Pesquero, Valparaiso, Chile [2]Instituto de Fomento Pesquero, Other, Chile

The Discard and Bycatch Research Program in Purse Seine Fisheries of Small Pelagic Fishes is a scientific observer program implemented in Chile since 2014 which aims to collect technical background to be used in the preparation of a national plan to reduce discards of target species and bycatch including seabirds, mammals and marine turtles. In this way, it is intended to advance in the implementation of an ecosystem management-based approach. The methodology considered gathering information through two sources: the data obtained directly from fishermen through a self-report log of each fishing trip and the data obtained on board through fisheries observers in vessels that operate from different ports in the study area.

Unlike traditional monitoring programs that holds the Government of Chile on a number of artisanal and industrial fisheries, the methodological structure was modified, including extensive diffusion work in land, carried out mainly by the same scientific observers. The shift to a human dimension focused on users of the fishery was necessary due to the nature of the study variables and the large-scale fleet that includes more than 500 vessels (semi-industrial) with coastal operation from multiple points of landing between 33° and 40° LS. This fleet has a complex organization system, medium to low educational level of the fishermen, and high distrust in research and fisheries management.

The approach of this program allowed to increase the level of participation with compliance in the delivery of logs which changed from 1.320 (24%) in 2014 to 4.296 (69%) in 2015. A significant difference was also observed in the number of trips made by observers, increasing annually from 1.3% to 2.1% of all fishing trips. This coverage increase is mainly explained by the interaction process that led to build trust and linkages that changed the willingness and availability for receiving observers onboard. The analysis of the results are showing new paths that contribute to propose to the Fisheries Authority, alternative regulatory, operational, cultural, or other changes whose implementation promotes the reduction of discards and bycatch in these fisheries.

Observer Professionalism Workshop

Leaders: Reuben Beazley and Amy Martins,

Most people won't argue that being an observer is a very challenging position. We strive to make the job better, safer, and more secure. An Observer Professionalism Working Group, Safety Working Group, and Training Group were established in 2006. Best practices and solutions to the most challenging issues related to observing were described in products from the various IFOMC working groups (http://www.st.nmfs.noaa.gov/ifomc2009/workGrps.html). Over time there have been focuses on social equity, support and opportunities, employment standards, and wages and benefits. These continue to be important aspects to being an observer.

Because of tragic loss of lives and disappearances of observers while on the job, we felt that it was necessary to review and discuss specific issues surrounding observer safety and personal health in this current workshop.

Participants

Kit VanMeter, Dispute Resolution Coordinator, NE U.S.

Ken Keene, Atlantic Pelagic Longline, NOAA SERO, Miami FL

Pat Carrol, Observer, NOAA SEFSC, Galveston, TX

Bubba Cook, World Wildlife Fund

Elizabeth (Liz) Mitchell, Association for Professional Observers (APO)

Simione Cagilaba, Former Fiji Fisheries Observer

Patrick Nugent, MRAG UK

Jaclyn Smith, NOAA OLE, AK

Robert (Bob) Hogan, NOAA General Council OLE, Silver Spring MD

Ches Rose, Seawatch Newfoundland

Part 1: Conflict Resolution Training and Medical

Kit VanMeter

Why include "dispute resolution" as part of observer training platform?

- Foster a safety culture with observers, fishermen, and other involved

stakeholders
- Initial training:
    - Identify dispute situations with questionnaire for observers
    - Recognize personal styles and those of others
    - The current problems now are drug use and observers are hesitant to report it for fear of losing their job
    - Know escalation factors

Ken Keene

Infectious Disease – Awareness, Recognition, Prevention, and Response

- Staff infections/ MRSA (super bug)
    - Most are antibiotic resistant
- Two types
    - Community Associated MRSA (CA-MRSA)
        - Genetically different from HC-MRSA
        - Commonly manifested as skin infections
    - Health Care Associated MRSA (HC-MRSA)
        - Occurs in a medical setting
        - Typically more resistant to conventional antibiotics
- 20-30% of people are shown to carry some form of Staff in their nose
- < 2% have MRSA
- Pervasiveness ultimately a result of historic overuse of antibiotics
- Causes
    - Crowding
    - Contact
    - Compromised skin
    - Contaminated items
    - Cleanliness
- Symptoms
    - Skin infections (Pimples, boils, 'Fish Poison')
    - Can manifest further into organs => fever and chronic illness
    - Described symptoms – yellow in center of wound, joint pain, fever, headache, sweating
- Precautions
    - Hygiene
    - Keep wounds clean
    - Do NOT share personal items
    - Wear Personal Protective Equipment (PPE) – cover wound
    - Advise and care for potentially infected crew

Pat Carrol

- Community Acquired Diseases
    - MRSA, Hepatitis, Meningitis, Bed Bugs, etc.
    - Mattresses are subsequent "hot-spots" (steralize mattress in sunlight)

    - Cover mattress with some sort of barrier
- Tuberculosis
    - More common internationally (outside the U.S.)
    - Good idea to perform regular checks
- Hepititis
    - More common with high drug-use individuals (type C)
    - Has a long "shelf-life" on surfaces
    - Must be aware of potential infection sites
- Meningitis & Influenza => community acquired
    - Potential for epidemic/ mass infections

Noteworthy that most providers do not provide health insurance while observers are the most likely employees to be exposed to a disease at ground zero. Programs should develop a list of illnesses

Discussion: Conflict Resolution Training and Medical

Reuben Beazley – Do we observers, know what is available for medical supplies/ equipment onboard the commercial vessels of deployment?

Tom Menino (EWTS, NE observer) – Experience in AK reflects excellent equipment and facilities for the treatment of medical situations. However, these vessels are large and deploy for extended periods of time. In the Northeast, equipment and facilities for addressing medical situations onboard commercial vessels is woefully inadequate, if existent at all. These are comparatively smaller vessels, deploying on shorter trips, and sometimes in extremely depressed fisheries (NE groundfish).

Phil Brown (Techsea) – Ultimately observers are responsible for their own health care and disease prevention and must be proactive/diligent to the nature of disease risk. "I carry MRSA medication and personal first-aid materials."

Christa Colway – NOAA requires all R/V personnel to have regular TB tests for deployment qualification.

Unidentified, Hawaiian Observer – Observer carries medication for MRSA and other health precautionary items when going on long trips as he believes he needs to take safety into his own hands. He stated he previously was an ambulance driver with first aid experience. Also stated crews will use an observers' personal items more than expected, ie toothbrush, nail clippers, and razors. First contact for proper medical care could be Coast Guard vessels. He emphasized observers supply their own first aid to supplement on-board resources (meds, staples, syringes, etc lots of anecdotes) stating you can't rely on the vessel's safety kit because they may not have one or it could be expired

Reuben Beazley's response – Wants to see improvement of first aid equipment on vessel(s)

Christa (Westcoast Groundfish) – Annual requirement of TB testing

Amy Martins – The NE Observer Program is expanding the training for physical and mental responses to medical issues. Further, there is an effort to expand the available support for

observers. There is not currently an EMT component of observer training, but it is certainly worth exploring.

Part 2: Regional Fisheries Management Organizations – Observer Safety

Bubba Cook

- Professionalism and provision of adequate safety resources for observers are directly related
    - Joseph Banks, Charles Darwin, Robert Clark were the at-sea scientists that are the progenitors of modern fisheries observation. They laid the foundation for much of what we know about the ocean today. This is a proud and noble tradition!
- Observers must know that there is a system that supports them. It's one thing to have policies and procedures in place, but observers must *feel* as though they are valued.
    - Are adequate resources available?
        - Management response is critical. *How* you respond is as important as the response itself. Observers should never be made to feel that they were at fault for a threat, harassment, or worse against them.
        - Observers must have confidence that the system will support them.
        - Management must keep observers informed => follow up with incident response on a periodic basis. An observer cannot feel as though their report goes into a "black box" with no response.
- Management authorities cannot foster retention and trust if observers do not feel that they are cared for
- Management authorities must also address recourse for offenses. There must be clear and consistent consequences for offenses against observers.

Elizabeth Mitchell

Transparent Reporting – Observer Harassment, Injury, and Death and Other Observer Reports in Regional Fisheries Management Organizations (RFMOs)

There is a particular need for improving the transparency of observer reports and complaints in RFMO observer programs because at least 5 observers have died or disappeared under suspicious circumstances over the last 6 years in RFMO fisheries, none of which have been reported publicly by the managing agencies,

Publicly reporting observer harassment and interference and especially death is important because:

- It is a public interest issue and would allow for the ease of finding information regarding what observers are experiencing;
- Facilitates monitoring the effectiveness of observer safety measures;

- Facilitates monitoring the effectiveness of RFMO observer programs in general; and,
- Increases public confidence in the monitoring programs.

Suggestions for increased transparency in RFMO observer programs:

- Establish an educational web-based portal for all RFMO observer programs where all resources are in one location and/or otherwise easily accessible to the public;
- Include observer sampling protocols, manuals, and training materials;
- Include existing observer program reports and data;
- Include a description of observer programs under RFMO management;
- Identify the chain of custody of observer data and information in various RFMO observer programs;
- Establish independent resources for observers such as counseling and mental health resources and develop a reporting hotline for observer harassment;
- Recommendations for management protocols, including publicly tracking observer complaints.

Simione Cagliaba

Legal Issues Regarding the Protection Measures for Observers

Complexity of Prosecuting Observer Reports

- There are limits to the extent of law, especially at sea and these should be clearly outlined and understood by all;
- Follow-up on observer reports are not taken seriously due to a number of factors:
    - Responsible officers are not adequately trained or experienced
    - Inadequate procedural delays in the investigative process, damaging the integrity of the whole chain of evidence;
    - Lack of transparent security and isolation of evidence to prevent tampering and contamination;
- Response to any observer report is very slow since normal procedures dictate mandate a full debriefing.
- Observers needing immediate assistance (those who experience harassment, interference and who are reporting violations) must be fast tracked into the debriefing process. This is especially important to maintain the credibility of the observer because the element of surprise and confirmation of alibis is usually lost when there are delays in debriefing.
- There is a need for clear roles and accountability of observer program managers and enforcement regarding their culpability of attending to the needs of an observer experiencing harassment. The observer has to know who they can expect to protect them.

Discussion Part 2: Regional Fisheries Management Organizations – Observer Safety

Brian Avery (Savatech Nova Scotia) - Believes he was intentionally locked in bathroom to hide him from seeing “something” and he felt intimidated when trying to find out what

happened. Understands one (observer) vs. many (crew), and difficulty with lack of evidence and consequent lack of confidence in reporting and when trying to prosecute later.

Reuben Beazley – There is an increasing need for a faster feedback loop. The delay in the reporting process is an ongoing issue in observer programs that impacts prosecution of violations. There needs to be protocol instituted which will facilitate timely return of information and protection of evidence

Bubba Cook – Federal enforcement protocols are not easily changed. Continued communication with observer (follow up) is critical and to let them know their report is valid and being looked into.

Isaac Forster (CCLMAR) - Please elaborate on the availability of information of report with respect to a portal for observer harassment.

Elizabeth Mitchell – There needs to be a publicly accessible place where information about RFMOs and their fisheries monitoring programs are easily accessible, including observer complaints of fishing violations and complaints of observer injury, assault, bribery attempts, harassment and interference. Deaths need to be reported publicly.

Bubba Cook – Acknowledged a need for a clearinghouse of information relating to RFMOs. However, there is difficulty navigating legalities, both domestically and internationally with respect to flag state, landing state, company origin, etc. The problem is that there is currently no real place to see a history of incidents with details. There are difficulties with confidentiality. Details couldn't be made transparent and available.

Elizabeth Mitchell – Acknowledged difficulties but that it is necessary and possible to report without revealing confidential information. The difficulties highlight the ongoing need to continue further efforts between conferences to explore and resolve the complexities involved in RFMO monitoring program transparency, jurisdiction and accountability.

Rich Kupfer (NOAA Pacific) - We have to make a commitment to observers, FIRST. All observer expectations are available publicly. Resolutions take time, but follow up is and does occur. All data of enforcement issues tracked.

Victor (CapFish, S. Africa) - Agrees with Bubba that accountability is critical. Why bother reporting if there is no recourse. In S. Africa, fishermen cannot continue fishing until resolution has been achieved.

Bubba Cook – Unfortunately, increased consequences to fishermen often correlate to increased consequences for observers. Achieving recourse is a tenuous process that needs to be handled on a situational basis. Increased responsibility to follow up with observer to make sure they feel protected and able to come forward.

Unidentified - Case resolution information should always be provided to observers once available. Manuals and field resources are online and available (NOAA Pacific) to facilitate public awareness of observer roles and responsibilities. "If you don't feel your organization is behind you, you won't be motivated to report incidents"

Part 3: RFMO – Observer Safety (continued); Legal Action and Enforcement of Observer Protections

Patrick Nugent

Safety Standards in the IOTC Observer Program

- Policy => Common Policy across programs
    - Linked to sister programs
    - Program-specific risk assessment
        - Used to develop policies
        - Scoring component; risk rating matrix
- Observer Standards of Conduct
    - Addresses conflict of Interest and Confidentiality
- Memorandum of Understanding
    - Outlines responsibilities for all
    - Sets minimum safety standards
    - Provides basis for pre-sea safety inspection

Jaclyn Smith

- Identify top priority incidents
    - Harassment, assault, etc.
- 3 hr. & additional 1.5 hr. training for all new observers
- The enforcement training includes role playing scenarios for common issues
- Community outreach – warnings issued through public forums, informal communication
- Retain the option to charge the company, or an individual

Bob Hogan

- Prosecutes civil, not criminal cases
- Requires due-process to accused
    - Takes time
    - Chain of evidence is difficult to establish
- Better course for remedy => resolution through OLE
- Results are published on website (http://www.gc.noaa.gov/enforce-office6.html)
- Environmental Protection Agency (EPA) judges hear cases (only 3 judges serving all obsever programs in the United States)
    - Slow wheels of justice

Ches Rose

- Mostly small vessels
    - Over 5,000 vessels under 35ft.

    - Crab, shrimp, groundfish
- Comprehensive safety legislation
- There has been a downward trend in fatalities. This could be attributed to:
    - Increased safety culture
    - Mandatory safety requirements for vessels;
    - Safety checklist employed by the observer prior to boarding (contains 'no-go' section for safety features and equipment that, if absent, trigger automatic refusal of boarding by the observer)
- N.F. vessels have the highest rate of safety compliance in Canada
- Non-compliance results in prohibition of departure from port until the safety issue is resolved.
- Challenges:
    - Jurisdiction
    - Legislation
    - Substance abuse
    - Safety standards of foreign vessels

Discussion Part 3: Safety, Legal Action and Enforcement

Reuben Beazley - Very important to address job related stress and mental illness

Michelle Tocorum - Some AK fish companies are acknowledging the importance of regular TB tests.

Tom Knudson, Center of Investigative Reporting - What is the status of Keith Davis' investigation?

Hogan – NOAA is not involved with the investigation. The incident is being handled by Panamanian authority and FBI. NOAA has no investigatory authority. There are many jurisdictional issues.

Rich Kupfer - FBI says it is still an open and active investigation. NOAA reacted fast and is conducting a national safety audit concluding in spring/summer of 2017. The safety audit is focusing into 7 areas.

Elizabeth Mitchell - Is NOAA asking observers to be involved in the safety audit investigatory process?

Kupfer – NOAA does not stipulate the safety audit contractor to specifically target observers in their inquiry. It is up the the contractor to decide if they wish to include observers or not.

Christa Colway - Smoking is an issue. How can we protect observers from second-hand smoke as it is a working environment?

Reuben – Newfoundland had passed the Non-Smokers Health Act 7-8 years ago mandating that the activity must cease. It was implemented within a year with surprisingly little resistance. Anticipated it would problematic, but legislation helped establish recourse for violations.

Keene – While the U.S. is collecting data on the relative occurrence, but the U.S. has little jurisdiction off-shore.

Pat Carrol – There is a cultural shift of less smoking in common closed spaces.

Joe Arceneaux - Without a formal collection of incident reporting, informal discussion and compilation of common incidents can be used for preparation for a hasty resolution. What is a reasonable recourse for observers that ignore "no-go" items on the safety check list and instead go on a boat with the overriding motive to make money or go when they aren't supposed to?

Nugent – In the UK, observers are automatically placed at the top of the list for the next available trip if there is a safety deficiency.

Reuben – It would be good to have the observer retrained in safety standards and policies so all adhere in the same way. This is especially the importance for considering the other/next observer to deploy on that vessel. Ultimately, there should be consequences!

Amy – In the NE U.S., observers who opt to sail when known 'No-Go' violations are onboard, this is cause for decertification. We are understanding if there has been an unintentional mistake/error and have several levels of recourse: pre-probation, probation, and finally decertification. For observers who have neglected expired safety equipment and have still taken a trip, this will result in decertification. Safety cannot be overlooked.

Pat Carrol – It is in the best interest of both observers and fishermen to heed safety protocols. There is a monetary penalty for violation.

Phillip Brown - I have concerns with emission exposure from engine exhaust. Has anyone addressed these concerns?

Universal response – no

Isaac Forster - Is it required for observers in the U.S. to have completed a first aid course?

Amy – Yes, first aid and CPR

Bobbi Wessel (A.S. Observer North Pacific) - Acknowledges strong community support in AK. There is a strong emphasis (drill, drill, drill) on incident reporting. Always felt comfortable with support system. The more detailed the safety, the more credible.

Hogan – Contemporaneous record (notes) are critical in forming a strong case for recourse in incident reporting. Notes are very important for a lawyer if written the day of the incident. Records are key as is the timeframe.

Susanne Brian - Feels comfortable with both the formal and informal support in the NE U.S. with regard to maintaining sanity and mental health. Massachusetts has readily available Narcankits, which are typically covered by insurance.

Amy – The NE program has not officially endorsed Narcan kits. There are concerns regarding potential health risks (physical and mental) after the application of the drug. Narcan is a brand name for the drug Naloxone, which is a prescription medication used to reverse the effects of opioids especially in an overdose. EMT's may carry Narcan as first responders.

There are concerns with allowing observers to carry Narcan since it may be beyond their training and scope, and often immediate medical attention is also needed which may not be available at sea. There can be side effects and reactions to the drug that would be difficult to manage at sea.

Roy Morris (North Pacific Observer) - Good connection with OLE but poor connection and support from Coast Guard. Is there any interest in having USCG participate in the discussion as they are the most likely on-site first responders to an incident with U.S. waters?

Amy – The USCG is invited to the initial observer training and NMFS also has a memorandum of understanding with the Coast Guard. USCG was invited to the conference but were unable to attend. Unfortunately, there is a high turnover in personnel within the Coast Guard boarding officers, which makes building a long-term relationship difficult, but much progress and a good working relations has been made. We have instituted the use of boarding reports, completed by observers in the event of a boarding. Unfortunately, it is often the case the observers may be treated the same as crew during a boarding, so follow up is needed.

Rich Kupfer (NOAA Pacific Islands) - It is worth pointing out the unaddressed element of tracking stewardship. That is to say, tracking the positive impacts of observers on incidents; not negative elements only.

Matt Kemp (North Pacific Observer Program) - To expand on Mr. Kupfer's comment, how likely is an incident to be reported without the prior informing of the vessel master.

Hogan – Judges are not likely to impute liability to owner or captain if communication of an incident is not established. Individuals may be prosecuted, but there is little liability beyond that. It is ultimately at the judge's discretion.

Alethia (Fiji Observer Program) - Fiji has adopted an Off Shore Management Creed. It began with a 3-year grace period, but now have fixed penalty notices. These can sometimes prevent a vessel from sailing. Fiji fisheries management is lucky that their national law system takes fisheries incidents very seriously.

Bubba – The FFA recently held workshops with judges and magistrates to educate and inform them about how to deal with fish and observer issues.

Casandra Donovan (NOAA Observer) - Wanted to point out her availability as a professional resource (recommendations) for career development.

Bruce Turris (Vancouver) - How do you address accusations of "bad observers" to ensure or propagate industry confidence in the management? How to provide feedback to industry?

Nugent – Sometimes have an advisory observer on board or incorporate extra-long debriefings. If an observer is not doing his/her job, it would likely reflect itself across other aspects of professionalism. Sometimes audits of statistics and data are used as metrics. However, it is usually self-resolving. That is to say, if an observer is confronted about questionable work practices, he/she fixes the issue so as to avoid further repercussion.

Amy- OLE will prosecute observers for data falsification. The structured nature of incident reporting apparently makes observers worried to report other observers not doing their job.

NMFS is working to develop a less structured system to allow for confidential reporting of poor observer conduct. There is a saying used by the State Police Department that promotes the police to work together to ensure that they have measures in place to help them be accountable, "who watches the watchers?" – we could say, "who observes the observers?" [From wicopedia **Quis custodiet ipsos custodes?** is a Latin phrase found in the work of the Roman poet Juvenal from his Satires (Satire VI, lines 347–8). It is literally translated as **"Who will guard the guards themselves?"**, though is also known by variant translations. Now this phrase is commonly used more generally to refer to the problem of controlling the actions of persons in positions of power, an issue discussed by Plato in the Republic. Socrates quotes that the best person "has a divine ruler within himself," and that "it is better for everyone to be ruled by divine reason, preferably within himself and his own, otherwise imposed from without." "Who monitors the Monitor?"]

I see that we all should take part to stand together to ensure that we are all doing the right thing.

Keene – Vessel masters are given a vessel/observer evaluation at the conclusion of every trip. Electronic monitoring also works as a check on observer behavior.

Sarah Cierpich (NEFSC FSB, Integrated Statistics) - Loves the USCG, they have been very helpful to her when she was an observer. Does the U.S. have a Good Samaritan law that applies to observers who aid in incidents?

Hogan – There is no law that ensures lack of liability. However, there is often situational leniency. Canada does have a Good Samaritan Law.

Keene – As in the case of the Atlantic Pelagic Longline Fleet, observers are covered for liability up to their respective level of training.

Keynote Speakers Statements which emphasize the importance of Fisheries Observers.

Samuel D. Rauch, III, Deputy Assistant Administrator for Regulatory Programs, NOAA Fisheries

- Observers need professional training and to act professionally. Observers are ambassadors and need to foster collaborative working relationships (which takes time).
- In many cases the observer is the most scientifically and safety trained person onboard.
- One of few things criminal in US Law that are intended to protect observers from harassment is found in the Magnuson-Stevens Act.
- Work is intense, hazardous. Observers need a safe onboard environment & sea worthy vessels.
- The fact that observers can refuse to board an unsafe vessel has promoted the safety of vessels.

William A. Karp, NEFSC's Science and Research Director

- Acknowledged public ownership of natural resources, citing the Doctrine of Public Trust and the need for accountability;
- Logbooks are a primary source of information but there are concerns of bias (giving rise to the need for unbiased data through observer programs);
- Management authority should set standards;
- Observer programs will continue to rely heavily on observers;
- "While they are not our employees, observers deserve our support." Emphasized the need for observer training, support and safety;
- Acknowledged an increased need for observers with concurrent increased investment into developing and supporting the observer workforce;
- Perhaps most valuable in reducing errors is the attitude of the person in charge of data collection.
- We learn the most and get best data when work effectively with industry and partner with fishermen.
- A collaborative partnership framework is needed for implementing monitoring programs, including work with NGOs, fishermen, foundations and observers;
- Need more, better, timely, high quality, objective, verifiable, accountable data as importance of data increases for scientist to do their job.
- Observer can: be flexible to changing conditions; outreach in the community; be a bridge between agencies, fisheries, & port samples.
- Moral obligation to understand what is happening "out there" on the high seas.

Electronic Monitoring Workshop

Leaders: Howard McElderry and Dennis Hansford

There is a high level of interest to deploy Electronic Monitoring technologies where its efficacy, operational feasibility and cost effectiveness can be demonstrated. The technical sessions in this conference have described a variety of cases where EM technology is being successfully put to work. The institutional arrangements for the delivery these programs have only been mentioned in passing, without specific discussion of the details. The purpose of this workshop is to discuss the business environment for program delivery in greater detail.

To help explain this topic it is useful to recognize that successful deployment of EM involves both products and services which are usually provided by EM technology vendors, hired by fisheries agencies, or industry groups, or potentially others. The offerings of EM vendors are the result of their innovations and investments, as they seek to develop product and service solutions to satisfy an emerging market demand. The business decisions for EM vendors simplify to an assessment of the opportunity, risks and rewards. EM vendors are willing to invest capital for the development of EM products and services if there is reasonable likelihood of creating opportunities that provide a return on their investments. The end user, or purchaser of these solutions, directly influences this supplier response in the way their needs are defined, the size of markets created, and the purchasing policies employed. It is helpful to think of these concepts collectively as 'market forces'.

Does the use of EM technologies make data collection more accurate, timelier, and more cost efficient? These are some of the aspects that end-users envision being addressed through the implementation of EM. They've identified a number of policy and data-related challenges presented by adoption of EM. These include the handling of the enormous amount of data involved and effects on time series of data used in stock assessments. But the most talked about challenges are the relative costs of various approaches and who pays. Thoughtful solutions to these cross-cutting issues and fishery-specific challenges requires vendor and end-user collaboration and planning. This was the dialogue of this workshop.

The business of EM is very new and there are few other business examples from which to learn. In fact, it is only the very recent availability of EM technology that has opened the door of possibilities to monitoring fisheries with automated technologies. Ultimately, we are seeking innovation to satisfy the 'better, cheaper, faster' market expectations and it is timely to consider what the market forces look like and evaluate if they are working effectively. We examined this topic with two separate panels. The first group represented EM vendors who provided their market perspective of the strengths, weaknesses, opportunities and threats. This was followed by a panel of end users to respond and provide their own perspective.

Part 1 – Electronic Monitoring Vendors Panel

Howard McElderry – Archipelago Marine Research Ltd.

Based in Victoria BC and founded in 1978, the service focussed company has three main business areas including marine environmental assessments, at sea observer programs and electronic monitoring. The company's 30-year history with at sea observer programs, were over 3,000 seadays are delivered annually, was the basis for pioneering electronic monitoring technology, now 17 years underway, with over 600 systems deployed, 7 fully operational fishery programs, totalling about 30,000 seadays per annum. An iceberg is a useful metaphor for EM programs, where the visible portion is the technology and the less visible parts include the service framework, and all parts make up an effective monitoring system. Technology based monitoring can be very cost effective and this is demonstrated by several existing fishery programs. Program design is key, where the monitoring objectives, operational requirements, fishery characteristics and other factors are considered to ensure cost optimization. Provision of EM is really two businesses: the product business and the service business. The two have very different market requirements, competencies and level of risk. Key messages to end users include the following:

- Prototypes are not the same as products – High performance expectations demand that EM products be properly tested at scale before they are deployed in commercial applications.
- Agency EM policies should encourage innovation – A healthy, dynamic EM product environment is one where EM vendors are incentivized to make investments to develop EM technology; policies such as open source discourage investment of private funds.
- Include EM Vendors in program design stage - EM vendors understand program cost drivers best and should be included in the discussion of program design, rather than after when the detailed statement of work and requests for proposals is released.
- Technology development vision – Because the life span of deployed EM systems is typically 5 years or longer, and the rate of technology change is rapid, more thought should be given to technology integration, to ensure adoption without creating disruptive or costly transition.
- Data standards – There are no data standards for EM products or programs which is problematic for end users who share data or work with multiple vendor systems.

Mike Kelly – CLS Americas

CLS Americas is a global provider of satellite communications and the largest provider of electronic reporting systems, including VMS. CLS has operations in 16 countries and annual revenues of $125m. EM product development occurs within the intersection of three independent drivers: what is technologically possible, where there is a business need for the technology solution, and where there is a willingness to pay for the solution. This intersection, or sweet spot, defines the setting where product development makes sense. The next facet for a company to consider product development is through an analysis of the market. There are several aspects to this such as market size and scope, rate of change, characteristics of other competitors, competitive advantage, and others. CLS has mostly concentrated on the development of sensors and has been slow to consider the EM market. A distinction is drawn between the government and the commercial market, where the former is often important in early stages and the latter is ultimately where the market will

develop over time. Hence, in considering long term sustainable products, it is important to consider the commercial market, including willingness to pay, purpose of the technology (e.g., compliance), value add opportunities (e.g., vessel maintenance, fuel efficiency, building public acceptability, etc.). This conference, and discussions with participants has been really beneficial to learn more about product needs to help guide and inform business decisions.

Faustino Maganto – Satlink

Electronic monitoring is often seen to be in conflict with at sea observers, when it should really be seen as a tool to support observers. EM is a tool to support observer programs and help increase coverage, particularly on vessels where there is not enough space for an observer. Observers can be involved in the design and installation of EM systems on vessels, and can carry out the analysis of EM data sets. Hence, observers can participate in fisheries monitoring without having to go to sea, where they may be away from home for weeks at a time. [The balance of the presentation was a video describing Satlink's products and services]

Gabriel Gomez – Marine Instruments

Marine Instruments is located near the major fishing port of Vigo, Spain and builds ruggedized marine electronics, such as tracking buoys and EM products. The company was founded in 2003, has 110 employees and is part of a larger organization called the Arbulu Group. The Iceberg metaphor for EM is very appropriate, not only to describe the program but to highlight the importance of the technology aspect. Products and prototypes are not the same thing. Manufacturing is a skill that delivers products of consistent quality, available in the required volumes. EM is deployed in a hostile marine environment and performance expectations are high. Thus, many components of an EM system are purpose built and not off the shelf. EM systems also need to be tamperproof and easy to install in less than a few hours. Many fisheries operate across broad geographies where logistics are poor and technical skill sets low. Furthermore, the system should not be over specified, with more data collected than necessary. For example, Marine Instruments believes in the use of high resolution still photography, instead of video, in order to meet data needs at a much lower overall data storage requirement. EM product development is challenging because of the rapidly changing technology, end user expectations of declining cost, and multiple product versions over short time span. Market leadership in this environment requires investment and long term thinking. Standards are needed to define EM data sets, data transfer and interoperability. Open standards would help accelerate development and reduce costs. Integration between EM, ER and VMS functions should be improved. Current approach where a new box is required for each function drives up end user cost and reduces efficiencies.

Amanda Barney – Ecotrust Canada

Ecotrust is a charitable organization, built on a triple bottom line (economic, social and sustainability) philosophy to help address needs in coastal communities. Ecotrust has over 20 years experience conducting fisheries projects with small vessel operators in a changing environment. Ecotrust has a strong data technology/IT group working with the broad suite of fisheries data, facilitating their ability to incorporate EM into their programs. They use an open source platform for data capture, enabling the integration of other data sources such as electronic logs and VMS. They have developed their data analysis software as a proprietary resource, with methods and structures specifically tailored to individual application needs. Their experience working on a range of fisheries issues has led to a broader perspective of fisheries data, incorporating both resource data and market data, informing the whole story. Fisheries are different and therefore program and cost effectiveness comes with program design. There isn't a 'one size fits all' monitoring solution and one shouldn't expect simple easy solutions from technology. There is a lack of standards. What are the regulatory standards that define how a fishery should be monitored? As well, standards are needed to define data structures and data delivery methods. Open design standards can create interoperability between systems while proprietary systems have their place where there may be very customer specific methods of analysis.

Jared Fuller – Saltwater

Saltwater has been a provider of observer services for over 25 years. Our involvement in EM is motivated by the belief that EM could be a cost effective tool for collecting the data needed to manage sustainable fisheries. In that sense the EM workshop structure should be reversed so we, as vendors, could better understand the data needs from end users which include the fishery managers, the industry, and other stakeholders. It is difficult for all of us to see clearly down the road because of the rapid changes in technology. Moore's law predicts that technology will be twice as fast and half as cheap every two years, but translating this concept to practical fisheries applications is not easy. It is important not to be fixated on one particular piece of EM (the shiny bauble), but instead look at the whole management system, what technological advances will be achieved over two years, and what our goal posts should be. EM is standing on the shoulders of giants because of all the previous work by fisheries managers, observers, and others to sustain our fisheries. Full integration of EM will include the cost of analysis, a clear assessment of what can be accomplished, and open-ended thinking about what else may be possible. This could come from multiple directions. As an example, the Nature Conservancy is sponsoring work with machine learning for EM. In collaboration with SeaState and Chordata and with funding from the National Fish and Wildlife Foundation, Saltwater has developed an open source platform for EM data review. We chose to use an open source platform with the hope that it will drive down the costs of EM data review and inspire innovation by multiple developers, both from within and outside the world of fisheries. The software has been designed to be adaptable for different fisheries with the hope that different managers and regions will find it useful for the data issues in their particular fisheries.

Discussion

Question – Emma Fowler (NE Observer) – How do you manage apparent conflict between the privacy needs of crew on small vessels with the full deck video recording requirements of EM? What can be done to combat misuse of using blind spots for illegal purposes (e.g., discarding fish)?

Response – Several panelists responded by indicating that privacy requirements are often managed in several ways including only video recording in certain locations or times (only during catch retrieval), intentional blind spots (curtained area or foredeck where no video recording takes place), vessel monitoring plans.

Question (to Howard McElderry) – Mark Hager (GMRI) - How many of the listed implemented EM programs are from US. Any lessons learned from the many pilot programs that would be helpful to speed up implementation of existing fisheries.

Response – Howard McElderry - The list of seven were mostly from British Columbia, but included one from Australia and one from west coast US. The latter is the shore-based whiting fishery that operated with EM from 2004 to 2010, then again since 2014. Regarding lessons learned to help speed up implementation, perhaps the biggest challenge is with when fishery groups are very bracketed int their thinking and simply try to use EM technology as a surrogate replacement for an observer without considering the broader elements of program design. The examples shown in the presentation with very significant cost reductions are examples where this broader design is used.

Question – Gil Sylvia (Oregon State University) – Question to all panelists about the importance of incentives, particularly those offered by agencies, in driving success in an EM program.

Response – Mike Kelly responded that Exempted Fishing Permits incent trials and provide regulatory flexibility. Industry cooperation can be very high with these programs.

Question – Melissa Mahoney (EDF) – Concerning fisheries that would like to adopt EM but the number of vessels is low, what can be done to address scale and make EM affordable.

Response – Amanda Barney responded that one way of building local capacity is through building partnerships with people on the ground in ports where EM services are needed. It may not always work with small numbers of vessels because of fishery specific design and set up costs but there may be economies realized by replicating from other similar programs. Scale is a big reason for making EM programs cost effective.

Question - Melissa Hooper (NMFS West Coast) – What do you think the government's role should be in assisting with the development of EM standards? If the role is to assist, what are the incentives for EM providers to participate?

Response – Mike Kelly responded that the government has done an excellent job with standards for VMS, laying out very specific requirements for vendors. This approach for environmental monitoring is much more difficult and would likely require a type approval process for companies for specific fisheries.

Question - Melissa Hooper (NMFS West Coast) – Concerning the high risk side of product development, do you think it is helpful for the government to assist with grants to help offset the risk, or does 'fear of failure create the right incentives to 'get it right the first time'?

Response – Gabriel Gomez responded that government assistance can be both good and bad. It some ways it can be used improperly by creating artificial competition. For example, the case where government has used grants to fund development a competing product to one that Archipelago has developed and paid for with its own funds. Jared Fuller provided another point of view, indicating that NFWF (US National Fish and Wildlife Fund) grant program has been very successful providing funds to help in small fisheries with limited resources.

Part 2 – Electronic Monitoring End-User Panel

Melissa Hooper – NMFS West Coast Region

NMFS relies on fisheries monitoring programs to inform management decisions. They want to encourage approaches that meet their information needs and provide cost effective, timely and accurate data. The regulatory approaches used to ensure this vary across regions and fisheries, varying in the level of specificity and flexibility. Highly specified programs are implemented through regulations (e.g., type approval) which can be problematic because of the time required to develop and implement regulations, and the difficulty in making changes when needed. A more flexible approach allows for adaptability to respond to new technologies, but lacks the specificity that defines program requirements so that vendors can most efficiently tailor their product development efforts. In terms of data, the government could have a role in the creation of open data standards for outputs from an EM system. Such standards could improve integration of EM data with other types of fisheries data. This approach is challenged by the tendency for different region and state programs to have their own preferences for data standards. A more open data standard could increase EM markets by making it easier for smaller fisheries to overcome entry barriers. Standards could be problematic for existing programs with non-conforming EM equipment. The fishing industry has a role in driving monitoring program cost efficiencies, by examining their operations and considering changes that could drive operational efficiencies for EM providers.

Nichole Rossi – NMFS NE Region

The NE Fisheries Science Center has been working with EM since 2010 and is currently working on two fisheries, the groundfish multispecies and the Atlantic herring mackerel fishery. There are two key themes for consideration – technology innovation and operational implementation. In terms of the first theme, there is a wide range of technology that can be considered and it is important to consider carefully what level of innovation is enough to satisfy the needs. There appear to be benefits to the integration EM and electronic reporting but these should be weighed against the costs and practicalities. Also, some newer low cost video systems (e.g., Flywire) offer advantages, including the potential for integration of underwater imagery. Finally, still image systems (e.g., Marine Instruments) may provide the needed resolution but with much lower data storage costs. The second theme, implementation, involves the uptake of EM. Coverage level is a key issue as EM is most suited for 100% levels and partial coverage levels generally have lower cost efficiencies. Implementation also requires support from many levels including council, industry and others. Support can come from acceptance that the EM can successfully address the fishery data needs.

Jon McVeigh – NMFS NW Region

The NW Fisheries Science Center runs the observer program and has had a role in helping get the west coast EM program off the ground. They participated in the collaboration with industry, council, agency, providers and others, that led to the creation of the program. Observers also played an important role in validating EM, providing complimentary data sets that could be used for comparison. While the EM program is mostly for compliance purposes (presence or absence of discarding events), collaboration between the EM and observer programs has led to discussion about how EM could be used for science purposes. The development of EM technology also provides benefits for observer programs with tools such as small, portable, deck-friendly tablets to help observers move to paperless data recording methods. Simpler, portable data collection systems (e.g., Flywire) may also provide data to augment observer data. EM technology applications for shore-based monitoring may also be beneficial, improving integration between at-sea and shore operations. Finally, whereas EM is often introduced to reduce monitoring costs, it is important to be mindful of impacts on observers. EM programs are often seen as a threat to observers by reducing job opportunity, particularly when there may be little transparency on potential observer impacts. Most programs depend upon a strong observer program and should make use of observers in the best way possible.

Jacqueline Smith – NMFS North Pacific

EM has been used in Alaskan fisheries and is proving to be a good tool for enforcement. EM data can be used to corroborate observer statements. Enforcement officials can also use EM data to perform targeted audits of vessel catch reports, or monitoring deck operations to monitor discarding or high grading. EM could have potential value for geo-fencing purposes, providing real time reporting of vessel positions and potentially enable dialog between enforcement and the vessel for boundary infractions. If EM systems report on

performance status of EM system, there is also the potential for dialog between vessel and enforcement when equipment failures occur.

Dave Colpo – PSMFC

PSMFC is the workforce behind the west coast EM program whereas NMFS is sets the program framework (elephant versus elephant rider analogy). An EM program has the following necessary components:

- Willing Participants – vessels operators must want EM.
- Camera Systems – technology to capture data aboard the vessels.
- Field Services – the provider of Camera Systems needs to provide technicians to install, service and repair systems aboard the vessels.
- Software to Expedite the Review – a software tool is needed to efficiently process imagery and record fisheries observations. Ideally, this technology integrates sensor information to enable more efficient identification of fishing operations and other events that require viewing.
- Database – a database is needed to house interpreted data, integrate with other fishery data, and store raw image and sensor data.

PSMFC has a staff of about four full time individuals who look after both west coast and Alaska program. About 70% of the effort is directed at the west coast, where about one-third of the groundfish fleet carries EM systems for 100% monitoring. The approximate data storage cost for a year of EM data is $75k (all data for 4 years).

The following comments were offered in relation to the EM Vendor remarks:

- EM needs is here and now – While technology innovation offers many opportunities in the future, these are not proven or can be operationally implemented now. Providing EM for the present needs to utilize technology that is proven and operationally ready today. Computer vision is an example of a technology of tremendous potential, yet it has little operational value at present.
- Open Source – While this may have a lot of potential in large markets (e.g., cell phones), it has no practical value for EM because the markets are too small. For example, there are 50,000 cell phones in the world for every fishing boat with a deck. Most of the fishing boats in the world do not have any form of monitoring. NMFS' open source policy for EM software is inconsistent with their practice of wide use of proprietary software in a range of applications (email, word processing, etc.).
- Incentivizing EM – It makes little difference to PSMFC whether the vessel chooses EM or an observer. On the west coast 100% monitoring is compulsory and vessels can choose between using an observer or EM. Ultimately, the choice should be based on what makes the most business sense for the vessel.
- It's Not Technology, Its People – EM is new and a lot of the people involved with operational implementation of EM don't really understand EM and what is needed to put it in use. Too many people are preoccupied with the shiny bauble of technology and not getting on with operational implementation.

Alfred 'Bubba' Cook – WWF

As mentioned by previous speakers the goal is about people and getting the information. Technology is not the end but potentially the means – 'potentially', because the role of technology needs to make sense, starting with clear definition of the problem, issue and challenge. WWF has limited resources and needs to be very judicious in its funding decisions. There has been some discussion on drivers, common internal drivers relate to faster access of high quality information. External drivers include programs such as MSC certification which specify improvements to data quality. As well, there is a trend toward greater transparency in order to minimize brand risk. Industries will move toward greater transparence because markets don't want to be associated with practices such as human trafficking, unsustainable fishing, and IUU fisheries. WWF is not a regulator but seeks to identify willing partners and act as a catalyst for change. WWF hosted the Emerging Technologies Workshop in Auckland, NZ earlier this year in order to bring vendors into the same room to learn about available technologies and promote discussion on possible integration opportunities. WWF has funded projects such as one in Papau New Guinea to integrate monitoring data in real time, as well as a project in Indonesia to test small, low cost EM units (Flywire) on an artisanal fleet. WWF feels its projects need to include willing partners and the project needs to make sense for end users. The project also needs to make economic sense, and the return on investment needs to ensure sustainability.

Wes Erikson – Fishermen BC, Canada [Extended Abstract provided by author]

2006 marked the implementation of 100% monitoring on all vessels in the British Columbia groundfish fishery, 10 years ago.

The British Columbia groundfish fishery has evolved over the last 30 years. This is the story of what it was like, what happened, and what it's like now, I grew up commercial fishing, and became the captain of my first fishing vessel at the age of 16. In 1987, at the age of 20, I had saved enough money to put a down payment on my own vessel, licensed for salmon and halibut. It was a two year plan. There was that much uncertainty.

Why does pain seem to be the catalyst for change and growth? In the 1980's, the BC halibut fishery was in pain and needed to change:

- Six days of fishing;
- 435 vessels;
- Poor quality;
- Limited fresh supply;
- Low price;
- Fish discarded; and
- Gear loss.

And lives were lost. We knew something had to change. The idea of Individual Transferable Quotas (ITQ) came from a fisherman who belonged to an industry organization. The organization presented the idea to the Department of Fisheries and Oceans (DFO). We

agreed on an individual allocation formula and industry worked with DFO to develop a set of rules to manage the fishery.

Fear almost always relates to future events, such as worsening of a situation, or continuation of a situation that is unacceptable. Fear that we may lose something we already possessed or fail to get something we demand. We designed the fishery to address our fears. The halibut fishery moved to a catch share fishery in 1991 and with it the beginning of third party monitoring (Hail requirements, Port Validation).

Years passed happily fishing halibut, encountering non-target species like rockfish, and in many cases throwing them away. I thought, 'Wow, don't imagine we will be able to do this forever.' Some of my fellow fishermen said, 'there is absolutely nothing wrong with discarding fish'. "There is lots of this bycatch stuff." "We wouldn't keep catching it, if there wasn't lots." We could cap out on all our allowable catch by discarding our overages. At-sea observers began to be deployed on vessels 5-10% of the time. Fishermen found innovative ways and persuasive arguments to avoid taking observers; "This is a privacy issue and you are violating my human rights", and there was Observer Bias.

In almost all fisheries, many species are encountered, and closed areas and discarded catch are difficult to monitor and this fact did not go unnoticed. As a result of pressure from the environmental community, we needed to prove ourselves sustainable. We needed to integrate the various fisheries. For the first time, fishermen began to understand that we needed more than just a commercial license to fish, we needed a social license. The next step in our evolution was to integrate and become accountable. This was no easy task. It began with admitting there was a problem (unreported catch) then beginning a process to address the problem. Seven fishing sectors participated in the process known as the Commercial Industry Caucus (CIC):

- Sablefish;
- Lingcod;
- Halibut;
- Dogfish;
- Trawl;
- Rockfish (inside); and
- Rockfish (outside).

We met for two to three days every month for a year and accomplished nothing. We could not even agree on who would chair the process. We were unwilling and not ready to change. Some would say our industry was not mature enough. We then reported our progress to the Department of Fisheries and Oceans. They issued an ultimatum:

1. All rockfish catch must be accounted for;
2. Rockfish catches will be managed according to established rockfish management areas;
3. Fishermen will be individually accountable for their catch;
4. New monitoring standards will be established and implemented to meet the above three objectives; and
5. Species of concern will be closely examined and actions such as reduction of total

allowable catch (TAC's) and other catch limits will be considered and implemented to be consistent with the precautionary approach for management.

Basically DFO said that we will account for all fish and prove it furthermore, if we couldn't figure it out, they would. We knew that would effectively end the fishery so, we had the incentive to find a solution, and we were motivated to accomplish it within the three year timeline. We selected an independent professional facilitator who helped us create a mission statement and developed a set of guiding principles. Then we began negotiating and eventually determined how to share fish and make our fishery defensible. This had to work and be affordable for the smallest boat (5m) in the fleet as well as the largest (50m). Knowing we would bear much of the cost, we realized that EM would be the only option for our smaller vessels. We envisioned the technology we would need to meet our objectives then worked with the monitoring company to develop the equipment and procedures. We began to realize that a fully monitored fleet would eliminate the question of "trust" from the equation. This would allow the industry to communicate with science and managers like never before.

In April 2006, we launched the Pilot Integrated Groundfish Fishery; seven fisheries, all with various catches, combined, and became fully accountable with over 70 species to manage in up to five management areas per species:

- One management plan;
- Catch shares for all species and vessels;
- Each vessel accountable for all catch – whether retained or released;
- Trading of quotas among vessels, gear types, and fisheries;
- 100% dockside and at sea monitoring; and
- One logbook for all vessels.

Logbooks are audited against video footage and then compared to the offload. The same logbooks are being use in science and management (we can trust the data now). At-sea data provides information on total catch mortality (retained and released)

How did we facilitate change?

- Define the objectives (providing rational for them),
- Identify participants,
- Begin a consultative process,
- Every fishery will have a different design to address specific problems and concerns, and
- With enough "incentive" any problem can be solved.

What were the principles of the process?

1. Involve the stakeholders (Involvement is the key to commitment. Without involvement, there is no commitment),
2. Impose a deadline (the work expands to fill the time allocated for its completion),

3. Allow the process to determine the roadmap to the objectives,
4. Continually re-visit the objectives, and
5. Trust the process. The process is as important as the outcome (the right answer too soon is the wrong answer)

Sometimes only a fishermen can talk to a fishermen.

B.C. fishermen now lead by example in conservation. We now have the ability to retain all species caught and account for all species discarded. Individual accountability and monitoring can eliminate illegal fishing activities, and our efforts were not conditional on something or someone else changing.

The five most important components of this fishery are:

1. Elimination of the race for fish,
2. Individual Accountability,
3. Transferability,
4. An innovative dynamic advisory body, and
5. Monitoring

I know that without these elements in my fishery, there was a guarantee for failure. Many of us now will survive and thrive because the system gives us the flexibility to be innovative.

This has allowed for much better working relationships with everyone involved in the industry and we will continue to evolve and mature over time because the system allows it.

Monitoring in fisheries benefits everyone - without exception.

Full accountability and monitoring are now accepted as the new reality. We think of it as paying for insurance. With it, our fishery is defensible.

Today, I am grateful that we made the decision to live in the solution rather than exist in the problem.

Dean Baigent – New Zealand Ministry of Primary Industries

New Zealand commercial fisheries have become very politicized recently because of recent work by a university professor, showing catch reconstruction over the past 65 years and much higher than reported discarding levels – 3 fish discarded out of every 4 fish caught. The foreign charter program and the QMS create a 'race for fish' environment where discarding could occur, but the agency believes that discarding levels are not as high as suggested in the study. This has prompted the ministry to implement new policies concerning electronic monitoring and reporting. There are about 1,100 fishing entities that collectively fish 99,000 days per year; 153 fish less than 20 days and 193 catch valued at less than $20,000. There is good observer coverage in the deepwater fleet (28%), yet the inshore fleet has very low coverage (4%) and is probably the greatest risk in terms of where discarding is occurring. The inshore fleet is difficult to monitor because of vessel size. NZ

has 4th largest EEZ in world and no boundaries with neighboring states. We don't believe there is an illegal or unregulated problem in these fisheries, but there is a problem with unreported catch. The focus is less about compliance and more about getting accurate, verifiable fisheries data to inform fisheries managers. The integrated electronic monitoring and reporting framework is intended to address this need. The integration of these elements provides more value than isolated systems. There is a set pathway toward implementation involving legislation, policy development, database management, and definition of reporting requirements. The QMS system in NZ provides a unique advantage because over 90% of the quota is owned by five companies who in turn provide catch entitlement to individual fishers. These companies have embraced the need to reform catch reporting and can provide significant leverage on the fishers. Implementation of this will probably result in fleet rationalization. The new reporting system will improve data quality and likely cause uncertainty with TAC settings. As well, the penalty regime was based on low contact – high consequence approach, and the new reporting system will be based on high contact. The ministry intends to focus on benefits over penalties, and take an incremental approach, 'eating the elephant one bite at a time.'

Discussion

Comment – Jared Fuller (Saltwater) – Offered a comment on open source discussion, emphasizing that it has been used in order to build collaboration.

Question – Bret Alger (NMFS NE Region) – Everyone has a different level of tolerance around how much they are willing to break the rules. In the design of EM, the proportion of imagery reviewed may vary. In programs where less than 100% imagery is reviewed, fishermen have the potential to break the rules and not get caught. In the BC fishery, where just 10% of the imagery is viewed, how much of a disincentive is this?

Answer – Wes Erikson – The BC system is much like a radar trap system where the fisher does not know what imagery will be reviewed and risk of the penalty is high. The disincentive is high.

Answer – Amanda Barney – While the image review may be less than 100% often analysis is performed on sensor data to screen for certain events such as closed area fishing. As weel, detailed investigation may occur with anomalies in the data set such as time gaps.

Question – Gil Sylvia (Oregon State) – Question for Dean Baigent about who pays for the EM/ER system in New Zealand, and whether the ministry is delivering performance standards or a complete operational program.

Answer – Dean Baigent – New Zealand has a levy system that collects funds from quota holders and is used to pay for programs such as this. The program cost should be viewed as installation costs and ongoing operational costs. NZ is a major seafood exporter and understands the importance of showing transparency.

Question – Philip Lens (FFA) – it is a pleasure to be here and be able to learn about EM. Question to the panel about whether EM data is admissible in court.

Answer – Dean Baigent – For New Zealand, EM is regarded as evidence and not an offence. Still need to go through an investigative process to gather and review evidence.

Comment – Howard McElderry (Archipelago) – Thanks to all the EM End Users for being flexible to incorporate EM Vendor comments in their presentations. EM offers the potential to be a significant game changer in creating transparency in fisheries. Fulfilling this is challenging and we are decades away from significant adoption. Often, when groups consider implementation in their fisheries, program design elements that have adverse cost implication, become hard coded in the design, making it harder to achieve this vision of wide scale adoption of transparency principles in fisheries.

Response – Dennis Hansford – While I somewhat agree, one needs to be mindful of the authorities and responsibilities that guide how various jurisdictions approach adoption of EM. In the US the process is slow but we are making progress.

Response to Dennis – Howard McElderry (Archipelago) - The larger vision of trying to achieve wide scale transparency across many fisheries means we can't let the current systems bracket our thinking. To make EM affordable, we need to find ways to open the market very broadly.

Comment - Mike Kelly (CLS) – Thanks to everyone for their involvement in this. It has been great to learn and gain new perspectives. It is great to learn about the ways the science community can use VMS and other data. Existing monitoring programs already provide a wealth of information and it is important to fully understand the capabilities of these programs before considering new technology. For example, an issue like zonal alerts to notify when a fishing vessel crosses a boundary already exist with current technology.

Comment to Mike Kelly – Alfred 'Bubba' Cook - There are so many new data streams and most fisheries agencies don't have the server banks to accommodate the data volume. The costs for this infrastructure is high and this will be a problem for agencies until the economies of scale make this affordable.

Comment - David Barrett – In response to McElderry's question 'What if monitoring costs were reduced to 25% of current price' in terms of the value monitoring provides. Monitoring protects places, times, markets and people. Monitoring in fisheries doesn't happen overnight and doesn't need to be viewed negatively. It is important to consider the pay off's that monitoring can provide.

Comment – Bruce Turris (CGRS, BC Canada) – Thanks to the panelists for their contributions. Suggests that future panels like this could include other end users such as ENGO's, buyers, marketers, independent scientists, to bring in a broader diversity of views. It is important to keep an open mind in how we view EM and its potential uses. For example, EM could be

used to monitor crew who carry out scientific sampling activities, or vessels which could be engaged to participate in scientific survey activities during normal commercial trips. Moving forward with advancement of EM technology depends on movement toward more open architecture systems where the work elements could be separate but integrated. Industry wants to avoid being locked into a setting where there is no competition. The government has an important role but development of technology isn't one of their roles. They should be setting the standards, defining the needs and identifying the uses. As well, the government should be ensuring the process is equitable to all users. While a commercial fishery is often tasked with paying the costs of monitoring, it is important to keep in mind that there are many who benefit from a well managed resource, including other stakeholders, the public, and the government itself.

Comment – Amos Barkai (Olrac, South Africa) – Some of the worst predictions of all time relate to the future potential of very common technology like computers and the internet. The fishing industry is one of the most data hungry industries of the world, yet it relies on 50 year old technology. Wide scale adoption of technology in fisheries will happen but is going to take a change in vision to get there. Failure to change seems to be a delaying tactic, where people stay with their comfort zone, rather than responding to the needs. Moving this forward requires proper funding and development of standards.

Comment/Question – Melissa Hooper – In my role of writing regulations, what specific barriers are there to innovation? What specific things should be considered? EM Vendors identified subsidies, scale, partitioning as elements.

Comment – [Unidentified from NZ] – Feels like this is being approached from an adversarial position when this is more about recognizing the value of data. There are many large players investing in Big Data systems and the potential for EM and ER data is immense.

Best Poster Awards

As with all our previous conferences, and in keeping with our desire to highlight the all-important poster presentations, we only give awards for what are adjudged to be the best posters presented.

At this conference the number and quality of posters was truly remarkable and resulted in excellent and interactive Poster sessions throughout the week as well as during the dedicated evening poster reception. The Conference Organising Committee together with a host of other judges scored all the posters presented and decided on the following winners:

First Prize: Deirdre Brogan - *How Do We Observe & Monitor Artisanal Tuna Fisheries In The Western And Central Pacific?*

Second Prize: Adriana Myers - *Conducting Effective Training Drills During Observer Safety Training: Building Muscle Memory And A Strong Safety Culture*

Third Prize: Lara Erikson - *Fishery Dependent Electronic Log And Remote Data Entry*

Congratulations to all our winners and to all the poster presenters for their fantastic displays.

Wrap-up Session and Where to From Here?

The final session of the conference was devoted to summaries about the conference and to hear from all delegates about suggestions for future conferences. Firstly, Mr Luis Cocas, the Undersecretary of Fishing and Aquaculture in Chile gave a summary of what he saw as the outstanding features of the conference.

Wrap-up speech

By Luis Cocas

Unidad de Biodiversidad y Patrimonio Acuático, Subsecretaría de Pesca y Acuicultura, Gobierno de Chile, Bellavista N° 168, piso 14, Valparaíso, Chile

Good morning everyone and thanks to Dennis Hansford for asking me to give the wrap up speech, certainly an honour.

First of all I would like to acknowledge all the people who, whether through presentations, posters, exhibitions of equipment, questions, and open discussion, or simply through their attendance made possible this outstanding 8th Conference. I think we all learned a variety of amazing new things that are happening out there in terms of fisheries monitoring and observation and if it were not for the Conference we never had known. I'm sure we all go back to our homes more motivated than we arrived and full of ideas (and business cards) to continue our work with passion.

In a very particular way I want to highlight the efforts made by all the fisheries observers who managed to come here, since they are one of the most valuables inputs to the Conference. After all the sacrifice that means to be at sea for months, working hard, away from the loved the ones, spending part of their precious time off and at their own expenses teach us a lesson of commitment.

Finally I would like to recognize the members of the Steering Committee for the enormous work and time they put into organizing this event, much of which is done behind the scenes and anonymous. They have allowed keeping alive this Conference for a 8th time and its projection into the future. And I said enormous time and work because I witnessed when they start planning this 8th Conference when we still were performing the last conference in Chile, 3 years ago. So let me ask a round applause for all.

After all the acknowledgements, I would like to wrap up this Conference with some questions that came to my mind during this week…

Why we all made the efforts I mentioned? Why are we here again? What brought together such a diverse group of people from different corners of the world?

There is no doubt that from its earliest beginning mankind has marvelled with the sea, has observed the sea, and has loved the sea. Because of the resources that sustained its existence, because it allowed discovering new lands and expands the boundaries of the

known world...or simply because of its beauty. The sea has sustained the mankind and somehow has determined its destiny. The fascination of which I speak is in the DNA of the humanity, but I think that this fascination is in a very special way in every one of us here today, and that is why at some point in our lives we decided to be either observers, fisheries scientist, managers or fishermen, in some way we found a way to feel or be near the sea.

However, the seas so plentiful of resources that for a long time seemed inexhaustible are now in trouble in most parts of the world. Lately it is becoming increasingly clear that current levels of exploitation are producing its exhaustion, and sustainability of fisheries is becoming seriously threatened. An important number of fishing stocks and their environments are now fragile and if no significant changes are made urgently and globally, fisheries may collapse in a near future. If this happens, there is no doubt that the effects will be catastrophic in terms of food security, social impacts and in the end, global stability. The humanity, and specially our generation has the moral duty to prevent this from happening. Then we have no choice but to ensuring the sustainability of the oceans and the road to do so is just through responsible management and rational use.

At this point there is no doubt that responsible management needs sound information to make the right decisions at the right time, and during the Conference we have learned that there are plenty of better tools than never before to accomplish this task. Some countries have made great progresses and the examples are substantial.

The human expertise is here, the tools and new technology are available at affordable cost, the know how is in this audience, but all of these elements are not going to work and solve the challenge we face unless the whole world is able to progress and use them. This is where the challenge from now on is, and where makes more sense than never before the fact of having an IFOMC every 3 years. If we are not able to share our knowledge, to share our experience, to facilitate the access to the tools we have seen, to other countries, especially to developing economies we will fail in reaching the ultimate goal that brought as here. It is essential the cooperation between institutions, between countries but above all, between people.

During this week we have greatly admired the progresses achieved since the last Conference, definitively there are a number of valuable advancements, but if we analyse a bit, easily can see that the vast majority of experiences presented, come from a reduced number of countries and the scope of our work only covers a limited part of the world´s fisheries. There are many countries that are trying to take the right steps to sustainability but somehow need help in this process and here is the duty and the challenge for those of us who have some influence; to advocate for the transferring of knowledge, for the standardization of information, for the access to technology, for the exchange between observer programs, tasks that must go and follow beyond this Conference. It is quite true that new technologies and highly qualified observers are needed and available in some countries, but it is also true that we certainly must make adjustments to cover other realities out there. We are challenged to create innovative and cost efficient ways to gather information, involving and validating the own fishermen and even the communities where they live. However, this last challenge, and particularly for developing countries, depends on a cultural change, which was not even a topic of this or previous Conferences. Here, the observers may play a leading role, them with their experience and proximity with fishing

activities can be the best connection between managers, scientists and fishermen or even communities.

Certainly on the road of achieving sustainability we will have to take drastic measures to eradicate fishing malpractices and increase control. However these changes must be done responsibly and are conditional to providing the observers with greater support, better safety and better equipment. Is not enough saying over and over again that they are important; at this point they must feel it.

The duty to bring about the change will not be easy and certainly we cannot continue as we are, it will require generosity and it will require sacrifices. Here I want to stop to remember our beloved friend Keith, whose work as an observer and whose life are an example of these virtues and a proof that the world can be a better place, and the change is in our hands. Keith legacy and life must be an inspiration for all of us, Keith made the ultimate sacrifice in the line of duty, if we all put only a fraction of the commitment he put I am sure we will accomplish the challenges we face.

Open Discussion

The Open Discussion period that followed Luis's outstanding summary provided an opportunity for delegates to provide feedback to the Organising Committee about the conference and suggestions for future conferences. This feedback is summarized as follows:

- There should be sessions focussing on:
    - stock assessment uses of observer data;
    - data gaps that could be filled by observers and/or Electronic Monitoring;
    - small-scale subsistence fisheries – those that feed families;
    - a panel comprised and chaired exclusively by observers;
    - a panel discussing the use of observers as educators;
    - a panel to discuss "Are we achieving sustainable fisheries using observers?";
- There should be more widespread use of social media and the internet before, during and after the conference, including perhaps live feeds for keynotes;
- More advance notice about the conference would have allowed for more attendance - especially for the individuals traveling from Europe
- Training materials for fishing crews could be made available that the observers could pass out
- More effort should be put into getting more fishermen attending the conference;
- Encourage more participation of observers
- Consider ways to record the positive things that occur during a trip – (like an incident report but for good things – not just bad).
- A silent auction to raise money
- A Working Group to increase opportunities for women in our field;
- Development of the Observer Professionalism Working Group
- The conference has a mostly western focus yet we saw that the west can learn a great deal from the fantastic observer programs occurring in the Pacific and especially Papua New Guinea.

The next conference:

Two organisations put forward offers to host the next conference - the 9th International Fisheries Observer and Monitoring Conference in 2018. These came from Marine Instruments, Spain and the Council for the Commission for the Conservation of Antarctic Marine Living Resources, Australia.

The Organising Committee decided that, in the interests of holding the conference in a continent where we have not previously held the meeting (Europe), that the next conference will occur in **Vigo, Spain in 2018**.

So please, stay tuned …… all delegates who attended the San Diego meeting will be contacted in due course as we arrange the next meeting in Spain.

Conference Attendees

Title	First Name	Last Name	Organization	Primary Address - Country	Primary Email
Dr	Eduardo	Aguilera	Servicio Nacional de Pesca y Acuicultura	Chile	eaguilera@sernapesca.cl
Mr	Brett	Alger	NMFS	United States	brett.alger@noaa.gov
Mr	Ernesto	Altamirano	Inter-American Tropical Tuna Commission	United States	ealtamirano@iattc.org
Ms	Sandra	Andraka	Ecopacific+	Costa Rica	sandrakag@gmail.com
Mr	Stuart	Arceneaux	Mr	United States	Stuart.Arceneaux@noaa.gov
Mr	Bramwell	Avery	Javitech Atlantic Limited	Canada	albert@javitech.ca
Mr	Dean	Baigent	Ministry for Primary Industries NZ	New Zealand	dean.baigent@mpi.govt.nz
Prof	Alitia Grikiyasawa	Bainivalu	Department of Fisheries, Fiji	Fiji	bainivalu.alitia@gmail.com
Dr	Amos	Barkai	Olrac SPS	South Africa	amos@olsps.com
Ms	Amanda	Barney	ECOTRUST CANADA	Canada	amanda@ecotrust.ca
Mr	William	Barnhill	National Marine Fisheries Service	United States	William.Barnhill@noaa.gov
Mr	David	Barrett	Pacific Monitoring & Compliance Panel	Canada	davlinpacific@gmail.com
Mr	Aubrey	Barto	Integrated Statistics, Inc	United States	edvorak@integratedstatistics.com
Ms	Katie	Beach	KT Beach Consulting	Canada	ktbeach@gmail.com

Mr	Samuel	Bear	IAP / NOAA	United States	Sharkman845@yahoo.com
Mr	Reuben	Beazley	Teamsters Union / Seawatch	Canada	reuben.beazley@live.com
Mr	Bryan	Belay	MRAG Americas, Inc	United States	amanda.lees@mragamericas.com
Mr	Lee	Benaka	NOAA Fisheries	United States	lee.benaka@noaa.gov
Mr	Jim	Benante	PSMFC	United States	jimb@psmfc.org
Mr	Phillip	Bizzell	NOAA Fisheries - NWFSC	United States	Phillip.Bizzell@noaa.gov
Dr	Lisa	Borges	FishFix	Belgium	info@fishfix.eu
Dr	Stephanie	Boudreau	Oceana Canada	Canada	sboudreau@oceana.ca
Mr	Eric	Brasseur	PSMFC	United States	Ebrasseur@psmfc.org
Ms	Deirdre	Brogan	Pacific Community	New Caledonia	deirdreb@spc.int
Mr	Philip	Brown	PIRO / NMFS	United States	Flipper184@hotmail.com
Mr	Maurice	Brownjohn	Parties to the Nauru Agreement	Marshall Islands	maurice@pnatuna.com
Ms	Suzanne	Bryan	NOAA Fisheries / NorthEast Fisheries Observer Program	United States	sbryan349@gmail.com
Mr	Christopher	Burns	Australian Fisheries Management Authority	Australia	chris.burns@afma.gov.au
Ms	Bobbie	Buzzell	AIS Inc	United States	bobbiebuzzell@gmail.com
Mr	David John	Byrom	Mrag Asia Pacific	Australia	dbyrom@mragasiapacific.com.au
Mr	Simione	Cagilaba	NOAA Fisheries / WCPFC	Fiji	sscagilaba@gmail.com
Ms	Jennifer	Cahalan	Pacific States Marine Fisheries Commission	United States	jcahalan@psmfc.org
Mrs	Michelle	Camara	TechSea International Inc	United States	ravenseeker1978@yahoo.com
Mr	Michael	Canino	MRAG Americas, Inc	United States	amanda.lees@mragamericas.com
Dr	John	Carlson	NOAA Fisheries Service	United States	john.carlson@noaa.gov
Mr	Patrick	Carroll	IAP World Service/ NMFS Se Galveston	United States	padriac3@hotmail.com
Ms	Lauren	Carroll	NOAA / Northeast Fisheries Science Center	United States	lauren.carroll@noaa.gov
Mrs	Jessica	Casey	Frank Orth and Associates	United States	jesker22@hotmail.com
Mr	Miguel Ângelo Gaspar do Couto	Chancerelle de Machete	Institute of Marine Research / Azores University	Portugal	Miguel.ag.machete@uac.pt

Mr	David	Chandler	NOAA Fisheries / Saltwater Inc	United States	davidchandler87@yahoo.com
Ms	Sarah	Cierpich	NOAA Fisheries / NorthEast Fisheries Observer Program	United States	sarah.cierpich@noaa.gov
Mr	Luis	Cocas	Undersecretary of Fishing and Aquaculture	Chile	lcocas@subpesca.cl
Mr	David	Colpo	Pacific States Marine Fisheries Commission	United States	dcolpo@psmfc.org
Ms	Christa	Colway	Government - Hotel Direct	United States	christa.colway@noaa.gov
Mr	Alfred	Cook	World Wide Fund for Nature	New Zealand	acook@wwf.panda.org
Mr	Scott	Coughlin	Fieldwork Communications / E.D.F	United States	scott@fieldworkcommunications.com
Mr	Kenneth	Coull	Scottish Fishermen's Federation	United Kingdom	k.coull@sff.co.uk
Mr	Grant	Course	Seascope Fisheries Research Ltd	United Kingdom	grant@seascopefisheries.co.uk
Mr	David	Cripe	US Coast Guard	United States	David.j.cripe@uscg.mil
Mr	Matthew	Cunningham	Integrated Statistics, Inc	United States	edvorak@integratedstatistics.com
Mr	Lucas	Curci	AIS Inc	United States	lucasc@aisobservers.com
Dr	Christopher	Cusack	REC	United States	chrisinju@gmail.com
Ms	Carla Sofia	Dâmaso	Observatory of the Sea Azores	Portugal	carladamaso@oma.pt
Mr	Michiel	Dammers	Wageningen Imares	Netherlands	michiel.dammers@wur.nl
Mr	Mathieu	David	CLS America	United States	mdavid@clsamerica.com
Mr	John	Davis	MRAG Americas, Inc	United States	amanda.lees@mragamericas.com
Mr	Jason	Dean	AIS Inc	United States	jasond@aisobservers.com
Dr	Donatella	Del Piero	Trieste Universi	Italy	delpiero@units.it
Mr	Chad	Demarest	NOAA Fisheries	United States	chad.demarest@noaa.gov
Mr	Peter	Desillier	U. S. Coast Guard	United States	Peter.a.desillier2@uscg.mil
Mr	Stewart	Desmeules	NOAA	United States	stewart.desmeules@noaa.gov
Ms	Jane	Dicosimo	NOAA Fisheries	United States	jane.dicosimo@noaa.gov
Ms	Cassandra	Donovan	NOAA Fisheries	United States	cassandra.donovan@noaa.gov
Ms	Courtney	Donovan	Pacific States Marine Fisheries Commission	United States	cdonovan@psmfc.org
Mr	Benjamin	Duffin	NOAA Fisheries	United States	ben.duffin@noaa.gov

Mr	Matthew	Duffy	NOAA Fisheries	United States	matthew.duffy@noaa.gov
Ms	Judith	Dwyer	Conservation and Fisheries and Oceans Canada	Canada	Judy.Dwyer@dfo-mpo.gc.ca
Mr	Jason	Eibner	NOAA	United States	jason.eibner@noaa.gov
Mr	Michael	Enzenauer	Riverside Technologies Inc	United States	michael.enzenauer@noaa.gov
Mr	Wes	Erikson	Pacific Wild Halibut	United States	erikson.w@gmail.com
Ms	Lara	Erikson	IPHC	United States	lara@iphc.int
Mrs	Jérômine Kompé	Fanjanirina	Indian Ocean Commission	Mauritius	jeromine.fanjanirina@coi-ioc.org
Mr	Andrew	Fedoruk	Archipelago Asia Pacific Pty Ltd	Australia	Andrew.Fedoruk@Archipelago-AP.com.au
Mr	Joseph	Flynn	Miami Observer Program	United States	joefishflynn@gmail.com
Mr	Isaac	Forster	CCAMLR	Australia	isaac@ccamlr.org
Ms	Emma	Fowler	Integrated Statistics, Inc	United States	edvorak@integratedstatistics.com
Mr	Andrew	France	Ministry for Primary Industries	New Zealand	andrew.france@mpi.govt.nz
Mr	Siosifa	Fukofuka	Pacific Community	New Caledonia	siosifaf@spc.int
Mr	Jared	Fuller	Saltwater Inc	United States	jared.fuller@saltwaterinc.com
Dr	Jason	Gasper	National Marine Fisheries Service, Alaska Region	United States	jason.gasper@noaa.gov
Mr	John	Giles	US Coast Guard	United States	john.p.giles@vscg.mil
Dr	Eric	Gilman	Pelagic Ecosystems Research Group	United States	FisheriesResearchGroup@gmail.com
Mr	Gabriel	Gómez	Marine Instruments	Spain	ggomez@marineinstruments.es
Mr	Peter	Graham	Forum Fisheries Agency	Solomon Islands	peter.graham@ffa.int
Ms	Emilie	Grau	NOAA Fisheries Pacific Islands Regional Office	United States	emilieadair@gmail.com
Ms	Heather	Gregg	North Pacific Groundfish	United States	hgregg19@gmail.com
Mr	Patrick	Gruenes	Integrated Statistics, Inc	United States	edvorak@integratedstatistics.com

Mr	James	Grunden	Alaskan Observers Inc	United States	jmsgrunden@gmail.com
Mr	Oscar	Gusman	Instituto de Fomento Pesquero	Chile	ifomc@arinex.com.au
Mr	Edel	Gutierrez	Navic	Mexico	egutierrez@navic.mx
Mr	Mark	Hager	Gulf of Maine Research Institute	United States	mhager@gmri.org
Ms	Kirsten	Håkansson	Technical University of Denmark / DTUA Aqua	Denmark	kih@aqua.dtu.dk
Mr	Ian	Hamilton	Archipelago Marine Research	Canada	ianh@archipelago.ca
Mr	Gregory	Hammann	Marine Instruments	Spain	ghammann@marineinstruments.es
Mr	Dennis	Hansford	NOAA / NMFS Office of Science and Technology	United States	dennis.hansford@noaa.gov
Mr	Dennis	Hansford	NOAA / NMFS Office of Science and Technology	United States	dennis.hansford@noaa.gov
Mr	Julian	Hawkins	IQMI	United States	julian@IQMI.ca
Mr	Craig	Heberer	The Nature Conservancy	United States	craig.heberer@tnc.org
Mrs	Katie	Herrera	Riverside Technology Inc	United States	katie.herrera@noaa.gov
Mr	Terry	Hillman	AOI	United States	t-hillman@alaskanobservers.com
Ms	Rebecca	Hoch	West Coast Groundfish Observer Program / TDEC	United States	rebecca.hoch@noaa.gov
Mr	Robert	Hogan	NOAA GCES	United States	robert.j.hogan@noaa.gov
Mr	Thomas	Holland	PSMFC	United States	thomas.holland@noaa.gov
Ms	Melissa	Hooper	Noaa Fisheries	United States	melissa.hooper@noaa.gov
Dr	Rob	Houtman	Fisheries and Oceans Canada	Canada	Rob.Houtman@dfo-mpo.gc.ca
Mr	Taylor	Howe	PSMFC	United States	taylor.howe@noaa.gov
Mr	Ilham	Ilham	Ministry of Marine & Fisheries Affairs	Indonesia	ilhamkkp11@gmail.com
Mr	Jason	Jannot	Government - Hotel Direct	United States	jason.jannot@noaa.gov
Mr	Etienne	Jarry	Cofrepeche	France	etienne.jarry@cofrepeche.fr
Mr	Dennis	Jaszka	North Pacific Groundfish Observer	United States	djaszka75@gmail.com
Mr	Haukur	Johannesson	Marel Seattle Inc	United States	haukur.johannesson@marel.co

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Mr	Jaegu	Jung	National Institute of Fisheries Science	South Korea	endless-alone@hanmail.net
Ms	Danielle	Kane	MRAG Americas, Inc	United States	amanda.lees@mragamericas.com
Mrs	Chelsey	Karbowski	Ecology Action Centre	Canada	ckarbowski@ecologyaction.ca
Mr	David	Karis	National Fisheries Authority	Papua New Guinea	dkaris@fisheries.gov.pg
Dr	William	Karp	USDOC / NOAA / Northeast Fisheries Science Center	United States	bill.karp@noaa.gov
Mr	Kenneth	Keene	NOAA Southeast Fisheries Center	United States	kenneth.keene@noaa.gov
Mr	John	Kelly	NOAA / National Marine Fisheries Service	United States	john.d.kelly@noaa.gov
Mr	Michael	Kelly	CLS America	United States	mkelly@clsamerica.com
Mr	Matthew	Kemp	Government - NOAA	United States	matthew.kemp@noaa.gov
Mr	Steven	Kennelly	IC Independent Consulting	Australia	steve.kennelly@icic.net.au
Dr	Yuna	Kim	Birdlife South Africa	Australia	contact.yuna.kim@gmail.com
Mr	Etienne	Klein	CLS	France	eklein@cls.fr
Ms	Michelle	Klein	Integrated Statistics, Inc	United States	edvorak@integratedstatistics.com
Mr	Thomas	Knudson	Reveal News	United States	tom@cironline.org
Señor	Iñigo	Krug	Fundacion Azti	Spain	ikrug@azti.es
Mr	Richard	Kupfer	NOAA Fisheries	United States	richard.kupfer@noaa.gov
Mr	Suraj Chandrakumara	Kuruppuge	Deaprtment of Fisheries and Aquatic Resources	Sri Lanka	ksckdumidi@gmail.com
Mr	John	La Fargue	NOAA Fisheries	United States	john.lafargue@noaa.gov
Mr	Jesse	Latham	IQMI	Canada	jesse@iqmi.ca
Mr	Scott	Leach	PSMFC	United States	Scott.Leach@noaa.gov
Dr	Jaebong	Lee	National Institute of Fisheries Science	South Korea	leejb@korea.kr
Mr	Minuk	Lee	National Institute of Fisheries Science	South Korea	oh10won@naver.com
Mrs	Soojeong	Lee	Korea Overseas Fisheries Cooperation Agency	South Korea	sjlee@kofci.org

Dr	Yong-Woo	Lee	Fishery Observation Science Program, NWFSC, NOAA	United States	yong-woo.lee@noaa.gov
Mr	Joshua	Lee	NOAA Fisheries Pacific Islands Region Observer Program	United States	joshua.lee@noaa.gov
Mr	Gonzalo	Legorburu	Digital Observer Services	Spain	afm@satlink.es
Mr	Philip	Lens	Forum Fisheries Agency	Solomon Islands	philip.lens@ffa.int
Ms	Celeste	Leroux	NOAA Fisheries	United States	celeste.leroux@noaa.gov
Mr	Julio Cesar	Limache Valenzuela	Instituto Del Mar Del Peru	Peru	jlimache@imarpe.gob.pe
Mr	Michael	Lindley	Alaskan Observers Inc	United States	mlindley@psmfc.org
Mr	Anthony	Lucia	MRAG Americas, Inc	United States	amanda.lees@mragamericas.com
Mr	John Douglas	MacDonald	Javitech Atlantic Limited	Canada	dmdeconomics@ns.aliantzinc.ca
Mr	Thomas	Maher	NOAA Fisheries Pacific Islands Regional Office	United States	tompatma@gmail.com
Ms	Melissa	Mahoney	Environmental Defense Fund	United States	mmahoney@edf.org
Mrs	Amy	Martins	NOAA Fisheries / Northeast Fisheries Science Center	United States	amy.martins@noaa.gov
Mr	Howard	Mc Elderry	Archipelago Marine Research Ltd	Canada	howardm@archipelago.ca
Mr	Terry	Mcdonald	Electronic Navigation Ltd	New Zealand	terry@enl.co.nz
Ms	Helen	Mclachlan	WWF UK	United Kingdom	hmclachlan@wwf.org.uk
Mr	Jon	McVeigh	Government - Hotel Direct		jon.mcveigh@noaa.gov
Mr	Marco	Mendizabal	ARAP	Panama	mmendizabal@arap.gob.pa
Mr	Thomas	Meninno	Integrated Statistics, Inc	United States	edvorak@integratedstatistics.com
Ms	Alicia	Miller	National Marine Fisheries Service, Alaska Region	United States	alicia.m.miller@noaa.gov
Ms	Jessica N	Miller	North Pacific Groundfish Observer Program / Saltwater Inc	United States	jnmiller.cofc@gmail.com
Ms	Elizabeth	Mitchell	Association For Professional Observers	United States	emitch@efn.org
Mr	Pieke	Molenaar	Wageningen University and Research	Netherlands	pieke.molenaar@wur.nl

Mr	Steven	Moon	Ecotrust Canada	Canada	amanda@ecotrust.ca
Mr	Rodolfo	Moreira	Observer (promarinha,seaexpert,popa)	Portugal	rodolfocurralo@gmail.com
Mr	Roy	Morse	Government - Hotel Direct	United States	Roy.Morse@noaa.gov
Ms	Adriana	Myers	Mrs	United States	Adriana.Myers@noaa.gov
Mr	Silvestre	Natário	Freelancer	Portugal	snatario@gmail.com
Ms	Lindsey	Nelson	North Pacific Groundfish	United States	ln.nelson@hotmail.com
Mr	Victor	Ngcongo	CapFish	South Africa	victor@capfish.co.za
Mr	Christopher	Noren	Alaskan Observers Inc	United States	norenchristopher@gmail.com
Mr	Patrick	Nugent	MRAG Ltd	United Kingdom	p.nugent@mrag.co.uk
Dr	David	O'Brien	Fisheries and Oceans Canada	Canada	david.obrien@dfo-mpo.gc.ca
Mrs	Sarah	O'Brien	Environmental Defense Fund	United States	sobrien@edf.org
Mr	Manuel Orlando	Ochoa Madrid	Instituto Del Mar Del Peru	Peru	ochoamadrid@gmail.com
Mrs	Jenn	O'Connell	Fisheries Sampling Branch, FM&RD, NEFSC, NOAA	United States	jennifer.o'connell@noaa.gov
Mr	Mike	Osmond	WWF	United States	michael.osmond@wwfus.org
Mr	Lucas	Pacheco	ARAP	Panama	lpacheco@arap.gob.pa
Mr	J. Vincent	Pelrine	Javitech Atlantic Limited	Canada	jvincent@javitech.ca
Mr	Joseph	Porau	National Fisheries Authority Papua New Guinea	Papua New Guinea	jporau355@gmail.com
Mr	Jeff	Pulver	Noaa	United States	jeff.pulver@noaa.gov
Mr	Troy	Quinlan	Techsea International Inc	United States	troy@techsea.com
Mr	Michael	Radziszewski	MRAG Americas, Inc	United States	amanda.lees@mragamericas.com
Mr	Eustacio	Ramirez	U.S. Coast Guard	United States	eustacio.m.ramirez@uscg.mil
Mr	Samuel	Rauch	NOAA National Marine Fisheries Service	United States	samuel.rauch@noaa.gov
Mr	Winston	Richardson	CLS America	United States	wrichardson@clsamerica.com
Ms	MELANIE	RICKETT	NOAA/NMFS/FMA	United States	melanie.rickett@noaa.gov
Mr	Neil	Riley	Government - Hotel Direct	United States	neil.riley@noaa.gov
Mr	Chris	Rilling	Noaa Fisheries	United States	chris.rilling@noaa.gov

Ms	Sofia	Rivadeneyra Villafuerte	Instituto Del Mar Del Perú	Peru	sbrivadeneyra@gmail.com
Mrs	Catalina	Roman	Instituto De Fomento Pesquero	Chile	CATALINA.ROMAN@IFOP.CL
Mr	Marlon	Román	Inter-American Tropical Tuna Commission	United States	mroman@iattc.org
Mr	Kevin	Romanin	Archipelago Marine Research	Canada	kevinr@archipelago.ca
Mr	Ches	Rose	Seawatch	Canada	crose@beothuk.com
Mr	Mort	Rosenblum	Reporting Unlimited	France	mort.rosenblum@gmail.com
Ms	Nichole	Rossi	Obeserver - Hotel Direct	United States	nichole.rossi@noaa.gov
Mr	Marcelo	San Martin	Instituto De Fomento Pesquero	Chile	MARCELO.SANMARTIN@IFOP.CL
Mr	Greg	Sanborn	MRAG Americas, Inc	United States	amanda.lees@mragamericas.com
Mr	Stefan	Sawynok	Infofish Australia	Australia	admin@info-fish.net
Ms	Gwynne	Schnaittacher	NOAA/North Pacific Observer Program	United States	gwynne.schnaittacher@noaa.gov
Mr	David	Schubert	Australian Fisheries Management Authority	Australia	schubby75@hotmail.com
Ms	Jennifer	Schultes	PIRO Observer Program	United States	jls176@humboldt.edu
Ms	Talilla	Schuster	Integrated Statistics, Inc	United States	edvorak@integratedstatistics.com
Mr	Casey	Scott	Frank Orth & Associates	United States	seagoat98@hotmail.com
Ms	Elizabeth	Scott Denton	NOAA / NMFS Southeast Fisheries Science Centre	United States	elizabeth.scott-denton@noaa.gov
Mr	Alvaro	Segura	Ecopacific+	Costa Rica	alvaro.segurah@gmail.com
Mr	Ryan	Shama	NOAA / West Coast Groundfish Observer Program	United States	ryan.shama@noaa.gov
Mr	Tobias	Shewan	Alaskan Observers Inc	United States	Tshewan@psmfc.org
Ms	Alayna	Siddall	Sportfishing Association of California	United States	alayna.siddall@gmail.com
Mr	Jean Pierre	Silva	Cofrepeche	France	jp.silva@cofrepeche.fr
Mr	Christiano	Silva Roma	APO	Brazil	christiano.sroma@gmail.com
	Cheree	Smith	Techsea International, Inc	United States	chereesmith@techsea.com

Ms	Heather	Smith	MRAG Americas, Inc	United States	amanda.lees@mragamericas.com
Ms	Jaclyn	Smith	Noaa Fisheries Enforcement	United States	Jaclyn.Smith@noaa.gov
Mr	Eric	Soderlund	International Pacific Halibut Commission	United States	eric@iphc.int
Dr	Kayleigh	Somers	NOAA NMFS NWFSC	United States	kayleigh.somers@noaa.gov
Mr	Duncan	Souter	MRAG Asia Pacific Pty Ltd	Australia	dsouter@mragasiapacific.com.au
Mr	Karl	Staisch	NOAA Fisheries / WCPFC	Micronesia	karl.staisch@wcpfc.int
Mr	Panca Berkah	Susila Putra	Ministry of Marine Affairs and Fisheries	Indonesia	pancazz37@gmail.com
Dr	Petri	Suuronen	Food and Agriculture Organization of the United Nations	Italy	petri.suuronen@fao.org
Dr	Gilbert	Sylvia	Oregon State University	United States	gil.sylvia@oregonstate.edu
Mr.	Luke	Szymanski	A.I.S Inc. & AFMOS		lukes@aisobservers.com
Mr	Netani	Tavaga	Fisheries Department of Fiji	Fiji	tavaga.netani@gmail.com
Mr	Wahyu	Teguh Prawira	WWF Indonesia	Indonesia	wtprawira@wwf.id
Mr	Aage	Thaarup	Technical University of Denmark / DTUA Aqua	Denmark	att@aqua.dtu.dk
Mr	Steven	Todd	WCGOP	United States	todd.steve@cox.net
Mr	Iago	Torres	Marel Chile	Chile	iago.torres@marel.com
Mr	Bruce	Turris	Canadian Groundfish Research and Conservation Society	Canada	bruceturris@shaw.ca
Ms	Vanessa	Tuttle	NOAA Fisheries	United States	Vanessa.Tuttle@noaa.gov
Mr	Bill	Tweit	North Pacific Fishery Management Council	United States	william.tweit@dfw.wa.gov
Dr	Catherine	Van Meter	FSB Integrated Statistics	United States	kitvanm@gmail.com
Mr	Jody	Vanniekerk	Pacific States Marine Fisheries Commission	United States	jodyolivervanniekerk@gmail.com
Mr	Rodrigo	Vega	Instituto De Fomento Pesquero	Chile	RODRIGO.VEGA@IFOP.CL
Mr	Faustino	Velasco	SATLINK	Spain	afm@satlink.es
Mr	Ruben	Verkempynck	Wageningen Imares	Netherlands	ruben.verkempynck@wur.nl
Mr	Jason	Vestre	PSMFC	United States	Jason.Vestre@noaa.gov

Mr	Charles	Villafana	NMFS	United States	charles.villafana@noaa.gov
Ms	Josee	Vincent	TechSea International Inc	United States	joseevincent@mac.com
Mr	Matthew	Walia	NOAA Fisheries	United States	matthew.walia@noaa.gov
Dr	Yuntao	Wang	NOAA Fisheries	United States	yuntao.wang@noaa.gov
Ms	Morgan	Wealti	Saltwater Inc	United States	morgan.wealti@satlwaterinc.com
Ms	Racheal	Weymer	Ecotrust Canada	Canada	racheal@ecotrust.ca
Mr	Andrew	Whatley	NOAA Fisheries	United States	andrew.whatley@noaa.gov
Mr	Bo	Whiteside	PSMFC	United States	Bo.Whiteside@noaa.gov
Mrs	Alicia	Williams	Javitech Atlantic Limited	Canada	alicia@javitech.ca
Mrs	Amy	Williams	Fisheries and Oceans Canada	Canada	amy.williams@dfo-mpo.gc.ca
Ms	Ann	Williamson	Integrated Statistics, Inc	United States	edvorak@integratedstatistics.com
Mr	Eric	Womack	MRAG Americas, Inc	United States	amanda.lees@mragamericas.com
Mr	Alexander	Woods	Pacific Networks Limited	New Zealand	alecwoodsnz@gmail.com
Mr	Christopher	Woolridge	NOAA Pacific Islands Regional Observer Program	United States	woolridgec@gmail.com
Ms	Carol	Zemina	Integrated Statistics, Inc	United States	edvorak@integratedstatistics.com