POSTERS

What Can We Learn From Observer Programs Around The World?

Poster 8, Paper 149: Six Basic Questions for Building an Observer Program

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Developing and implementing an at-sea fishery observer program can be confusing. This short presentation will address six (6) basic or foundational questions that should be answered by emerging programs, or those in development. There are no "right answers" to the questions. It is hoped that by developing the answers to these questions, programs can avoid many pitfalls to have impacted other observer programs.

Each answer will have its pros and cons. It is up to individual programs to determine their best solution.

The list is not intended to be restrictive. As things progress, additional questions will very likely arise.

Poster 7, Paper 120: The Importance of Fishery-Dependent Biological Data Collection by the At-Sea Observer

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On January 19, 2000, the Department of Commerce declared the West Coast commercial groundfish fishery an economic failure following the dramatic decline in fish catch experienced over the previous decade. However, the exact reason for the collapse was indeterminable due to a lack of basic scientific information on these fish. In response, NOAA Fisheries established the West Coast Groundfish Observer Program (WCGOP) in 2001 with the mission of collecting the basic fishery-dependent data which previously was lacking. In the fifteen years since the inception of the WCGOP, at-sea observers have proven to be an indispensable data collection resource and have amassed a robust fishery-dependent dataset with enormous potential for scientific use. The WCGOP observer dataset includes (1) detailed estimates of total discarded and retained catch; (2) weights, lengths, sex, age structure, and genetic information from numerous groundfish species, salmon, green sturgeon, and marine mammals; (3) invertebrate tissue samples; (4) viability estimates of Pacific Halibut; and (5) interaction information on marine mammals and seabirds. Understandably, collecting such vast amounts of information comes with a price tag and there are both monetary and spatial costs associated with carrying a human observer on board. Recently, as video monitoring, GPS, and electronic logbook technologies have improved, they have also been proposed as a potential replacement to the human observer. While, these new technologies have great potential for compliance monitoring, and may serve as an excellent aide to the on board observer, they remain incapable of doing the true science needed for assessing the status of this important natural resource. Here, we illustrate the rich dataset which has been collected by WCGOP observers over the past fifteen years and highlight the importance of the at-sea human observer in fishery-dependent biological data collection.

Poster 5, Paper 71: Five years post rationalization: Changes in fishing behaviors observed in the Astoria Groundfish Catch Share fleet

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The transition from a Limited Entry, trip limit based fishery, to a Catch Share IFQ quota system in 2011, was an important milestone in the management of the West Coast Groundfish Trawl sector and produced some immediate and notable changes in fishing practices. Since then, a few reports have demonstrated gains in vessel revenue and efficiency and shown steep reductions in bycatch of certain commercially important or overfished species. In this study, we tested these patterns on a local scale, specifically for the bottom trawl fishery in Astoria, Oregon, where annually, about one third of Catch Share trips coast-wide are landed and where acknowledgment of the program's benefits among fishermen is relatively high. Using the latest data from the West Coast Groundfish Observer Program, we examined catch and discard trends for three, broad IFQ species groups (rockfish, flatfish, and roundfish), and for priority or rebuilding species (including, pacific halibut, petrale sole, bocaccio, canary, darkblotched, and yellow eye rockfish). We analyzed fishing unit-effort metrics (e.g., number of tows per trip) and the observer data from five baseline years of pre-Catch Share (2006-2010) with the five years of post-implementation (2011-2015) to identify potential changes in fishing behaviors, as well as shifts in catch rates. Permutation test was used to statistically compare the differences between pre- and post-Catch Share implementation. The results indicated that retained catch rates significantly increased for the IFQ target species groups between the two programs, while the metrics of unit-fishing-effort all showed decreases. This implies improvements in fishing efficiency. Another positive change after Catch Share program implementation was the significant reductions in the discard rates for both IFQ species and overfished species. The benefits of Catch Share rationalization are discussed in this poster, within the context of the Magnuson-Steven's Fishery Management and conservation Act.

Poster 1, Paper 6: Situation du Gabon

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Translation in English as per Google see next page.

Situation du dispositif de surveillance et de suivi des pêches du Gabon

Contexte

Le Gabon dispose d'un littorale d'une longueur de 800 km, d'une Zone Economique Exclusive (ZEE) estimée à 213.000 km^2. Les eaux marines gabonaises sont rèputèes potentiellement riches en ressources halieutiques.

A l'instar des autres espaces maritimes, l'espace maritime gabonais est aussi confrontè à de nombreuses menaces sur ses ressources halieutiques et sur son environnement marin dèrivant des multiples activitès èconomiques et sociales dans les zones côtières et qui èchappent encore à la vigilance des services de surveillance des administrations compètentes, dèmontrent l'extrême nècessitè de concevoir des nouveaux outils de gestion de ces dernières.

Ces menaces se caractèrisent par :

- La prèsence des activitès de pêche dans les habitats et ècosystèmes sensibles (mangroves, estuaires, lagunes, baies);
- La pêche illicite ;
- Le non respect des mesures conservatoires pour une gestion durable des ressources halieutiques;
- la capture des juvèniles et des rejets en mer ;
- l'utilisation des engins de pêche prohibès.

Pour pallier cette situation et pour rèpondre aux insuffisances opèrationnelles rèvèlèes, le Gabon s'est engagè à renforcer son dispositif de surveillance des pêches par :

- o l'acquisition de nouvelles technologies de surveillance des pêches (THEMIS) ;
- o l'utilisation de nouveaux outils d'identification et de dètection d'activitès de pêche illègale (AIS et Radar côtier) ;
- o l'acquisition de deux (2) avions pour les missions aèriennes ;
- o le programme d'embarquement d'observateurs à bord dans les thoniers et chalutiers ;
- o la collaboration avec l'Agence Gabonaise d'Etudes et d'Observations Spatiales (AGEOS) pour la fourniture d'images satellites couvrant le territoire maritime gabonais où s'exercent les activitès de pêche.

Il se dèploie sur quatre (4) zones de pêches opèrationnelles à savoir : (i) la zone Nord (Cocobeach-Awanier), (ii) la zone Port-Gentil-Ombouè, (iii) la zone Ombouè-Mayonami et (iv) la zone Mayonami-Frontière congolaise.

Objectif gènèral

L'objectif gènèral est de lutter à l'èchelle nationale contre la pêche Illicite Non dèclarèe et Non règlementèe (INN) pour faire respecter les lègislations nationales, règionales et internationales de gestion des pêches et encadrer des activitès de pêches durables dans zone èconomique exclusive gabonaise.

Translation in English as per Google

Location of the monitoring device and monitoring of fisheries in Gabon

Context

Gabon has a coastal length of 800 km of Exclusive Economic Zone (EEZ) estimated at 213,000 km2. Gabon's marine waters are considered potentially rich in fishery resources.

Like the other marine areas Gabonese maritime space is also facing many threats on its fisheries resources and marine environment deriving its multiple social and economic activities in coastal areas and still escape the vigilance services supervision by competent authorities, demonstrate the extreme need to design new recent management tools.

These threats are characterized by:

o The presence of fish in the habitat and sensitive ecosystems (mangroves, estuaries, lagoons, bays);

o Illegal fishing;

o Failure interim measures for sustainable management of fisheries resources;

o the capture of juveniles and discards;

o the use of prohibited fishing gear.

To remedy this situation and to meet the proven operational shortcomings, Gabon is committed to strengthen its fisheries monitoring device:

o the acquisition of new fisheries monitoring technologies (THEMIS);

o the use of new tools for the identification and detection of illegal fishing (AIS radar and coastal);

o the purchase of two (2) aircraft for aerial missions;

o boarding program of observers on board in tuna vessels and trawlers;

o collaboration with Gabonese Agency for Space Studies and Observations (AGEOS) for the provision of satellite images covering the Gabonese maritime territory are exercised fishing activities.

It spreads over four (4) areas of operational fisheries namely: (i) the North Zone (Cocobeach-Awanier), (ii) the area Port-Gentil-Ombouè, (iii) the Ombouè-Mayonami area and (iv) Congolese Mayonami-border area.

Main objective

The overall objective is to fight against national fishing Illegal Unreported and (IUU) to comply with national, regional and international legislation fisheries management and oversee sustainable fishing activities in Gabon's exclusive economic zone .

Poster 10., Paper 161: Integrated Monitoring in a Disaggregated Fishery

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The Western and Central Pacific Ocean (WCPO) holds the world's largest tuna fishery with its waters producing 2,860,648 mt, or 83% of the total Pacific Ocean catch, and 60% of the global tuna catch. This catch was composed of four target tuna species (skipjack yellowfin, bigeye and albacore) caught by four industrial geartypes: purse seine (15 fleets), longline (34 defined 'fisheries'), pole and line and troll; with about 2000 vessels registered.

Regional fisheries management initiatives use observers as monitoring tools and require 100% coverage of purse seine effort (~ 2,300 observer trips), 5% of long line effort (~ 550 observer trips) and of all high seas transhipments (~ 550 transhipments). It is the 15 national and subregional observer programmes of the small Pacific Island Countries (PICs) that provide the majority of observer placements to meet these requirements in the tropical and subtropical tuna fisheries. PICs collectively have more than 750 active observers. Not only has this required individual national infrastructure development to support large observer programmes but the growth of communication and support networks among programmes to manage observers and their data in a mobile fishery often disembarking observers in a country far from their own.

The Pacific Islands Forum Fisheries Agency (FFA) and Pacific Community secretariat (SPC) support the integrated development of PICs observer programmes, key to this is in developing homogeneous data and training standards across the 15 PICs observer programmes that set benchmarks for the broader region. The Pacific Islands Regional Fisheries Observer (PIRFO) training and accreditation standards created a single set of standards for all PICs and created a benchmark for authorisation of providers by the WCPFC Regional Observer Programme (ROP). The vertical development of PIRFO qualifications also created a career pathway in PICs where employment was limited.

National and regional cost recovery initiatives created a business culture as observer service providers, with sustainable funding to meet national aspirations and facilitate regional agency support where needed.

Current E-Monitoring and E-Reporting initiatives are also being standardised among PICs to further improve coordination of their observers, data and improve observer safety.

Poster 6, Paper 106: Peruvian Logbook On-board Program: Living with the enemy

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Marilú BOUCHON[1], **Julio LIMACHE**[1], **Gersson ROMAN**[1] **and Manuel OCHOA**[1]

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The project of The Peruvian Logbook On-board Program was born in the decade of seventies, it started with a simple format that was used by the same captains or "patrones" of each fishery vessel. However this project ended due to reduce of budget.

In 1996, IMARPE re-start the project became in a Peruvian Logbook On-board Program and this continue until now. But a great difference is that is necessary the presence of an observer on board. In a first moment that notice was not happily for the crew because this situation implicit that one of them be left of the vessel. In those years IMARPE and the observers have been to argue with stakeholders until crews about the necessity of the take of information, and create any forms to have an observer on board.

Currently, after a lot of discussion, situations and activities, most of the captains and crews has a friendly relation with the observers.

Poster 9, Paper 157: Implementation of a discards and bycatch research program in Chile.

Marcelo SAN MARTíN[1]

Catalina ROMAN[1] **and Juan Carlos SAAVEDRA**[1]

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Discards and bycatch in fisheries around the world are nowadays an important issue that affects marine ecosystems and has to be recognized. Although that it's not a recent problem, it was possible assess the discard impact in Chilean fisheries only after deep modifications on the General Fisheries Law during 2012 through 20.625 Law. In addition to regulatory modifications, this law considered the beginning of a research program in main demersal fisheries of Chile, especially bottom trawl fisheries. The research program executed by scientific observers on board, looks for assess discards and bycatch magnitude on each fishery, the causes that provoke them and propose mitigation measures to reduce this issue. Since 2013 there are 11 fisheries under monitoring (artisanal and industrial) including important fisheries like common hake (*Merluccius gayi*), hoki (*Macruronus magellanicus*) and demersal crustaceans. Results obtained by this research program are a relevant input for fisheries management of the country, adding more and better information. This will allow establish management measures from an ecosystem approach that regards resources sustainability and their habitat. In this work, we will be showing the background and development of discard research program in Chile, furthermore methodological aspects implemented, where scientific observer work on board is essential.

Poster 2, Paper 43: OBSERVERS - THE FACE OF FISHERIES MANAGEMENT

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The Australian Fisheries Management Authority (AFMA) has long running internal observer program tasked to independently monitor commercial fishing operations in Australia. Observers are commonly referred to as the face of AFMA and are recognised as a conduit between fisheries management and the fishing industry. This gives observers unique insight into the mindset of industry and an understanding of the most effective ways for management to deliver important information.

To utilise this valuable knowledge a project was developed to use a visual multimedia package to educate fishers to the role of compliance officers and what to expect in the event of an inspection. This communication strategy relied on clear and concise language paired with an easily related visual demonstration of a routine compliance inspection. Although the dissemination of the video is still in early stages initial responses indicate industry is appreciative of the approach and find it very beneficial.

Visual multimedia has been identified for use in a range of applications including an observer training tool for observers and an effective way to convey changes to fishing regulations. The success of the project has paved the way for observers to be involved in future, similar communication strategies. The project has also highlighted the unique and varied skill set that observers have to offer fisheries management as well as the importance of retaining face-to-face interaction with industry.

Poster 4, Paper70: MEETING THE OBSERVER TRAINING AND DEBRIEFING CHALLENGES OF THE WEST COAST GROUNDFISH CATCH SHARE PROGRAM

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With the implementation of a catch share program in 2011, introducing Individual Fishing Quotas (IFQs) on the West Coast, came a host of challenges for the West Coast Groundfish Observer Program (WCGOP). Paramount among these challenges was a need to increase the speed at which data could be made available to a central vessel account system, in order for fishers and managers to track quotas in near real-time. This required a significant decrease in data entry and finalization times. The WCGOP met this challenge by utilizing a number of techniques, including the creation of an offline database, expansion of automated trip error checks, an accelerated debriefing schedule, and data form scan and upload procedures.

This IFQ program also brought with it a significant increase in the demand for observers and a need for increased training frequency and flexibility. By working closely with observer providers and creating a suite of new training/briefing options, the WCGOP has been able to meet the demand for certified catch share observers, while also providing opportunities for observers to move back and forth between the catch share and non-catch share programs. Crossover between programs has allowed for more observers to work year-round, potentially increasing observer retention. With greater retention, comes a reduction in the need for costly, time-consuming initial trainings. Having more experienced observers in the field also reduces the post-training burden on debriefing staff and improves data quality.

This poster will explore the various methods used by the WCGOP to meet the training and debriefing challenges of the West Coast Groundfish Catch Share program. It will highlight successes, lessons learned, and plans for continued improvement in these areas.

Poster 2, Paper 56: 40 Years of Observer Data in the At-Sea Hake Fishery

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[1] **NOAA Fisheries**

An analysis of all things "40" reveals the long, rich history of observer data in the at-sea Pacific hake fishery off the U.S. West Coast. From 1975-2014, data collected by the At-Sea Hake Observer Program (A-SHOP) has served for the successful management of a MSC-certified, sustainably managed fishery. To celebrate this long history, and focus on the number 40, a list of impressive statistics about the program has been compiled. The A-SHOP has changed greatly over the last 4 decades, but the core responsibilities of determining total catch, collecting species composition samples, and biological data on protected species has never wavered.

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How Do We Train And Prepare Observers, Provide Opportunities For Professional Growth And Reward Performance?

Poster 17, Paper 155: How do we train and prepare observers, provide opportunities for professional growth, and reward performance?

Samuel BEAR[1]

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The training of observers can be divided into 4 modules: safety, protocol, handling of captain and crew interactions, and species identification and handling. Each module should consist both of classroom learning and hands on exercise. While the exercises for handling emergency situations, and dealing with captains and crew are rigorously performed, hands on learning for protocol may be lacking. Observer trainees would greatly benefit by having a session on a working commercial fishing boat, if feasible, to observe firsthand how fishing operations are conducted and gain a better grasp of proper sampling protocol.

Observer programs could participate in international exchange programs, where proven qualified observers could partake in trainings and work for other programs abroad which could provide an opportunity to learn new protocol techniques and expand the observer's knowledge and skill set. Allowing observers to coordinate efforts with universities and researchers in areas of their interest could also expand opportunities. Observers in the field have unique opportunities to make observations, collect data, and even samples for both fisheries and non-fisheries related research. Of course the observers' primary duties would take priority for these situations.

Awarding observers who consistently perform well a bonus of sorts would encourage continued good performance and encourage others as well. A simple cash bonus, gift certificate, or even a small gift such as free t-shirt could provide additional incentive to produce quality work. An annual retention bonus could be awarded to observers that remain with a program. This could also encourage improved performance as well as provide incentive for an observer to remain with their program which could actually reduce costs over having to train a new observer that may not perform their duties as well.

Poster 19, Paper 164: A career in observing

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Observing has long been thought of as temporary position for new college graduates. Most contractors request a one-year commitment, yet due to high rates of attrition, many new hires do not fulfill this commitment. As an observer with 13 years of experience I have seen various reasons observers leave the position. Many stem from the notion that observing is not a viable career path. In the United States, there are various contracted observer providers, each competing for contracts every few years. Contract instability trickles down to job instability for observers in terms of work availability, benefits packages, and pay scales. Observers are not permitted to work for multiple contractors concurrently. In regions like the Northeast this results in limited work opportunities seasonally. In the scallop fishery there are multiple providers all competing for the same trips, leaving observers with less opportunity for work, or requiring contractors to reduce their employed observers. There is no system in place to protect observers from contract fluctuations, making it difficult to commit to the position long-term. Rapid observer turnover has many negative consequences for overarching goals of observer programs due to higher training costs, loss of rapport with industry, and potential reductions in data quality. If observing could be presented more as a career path, rather than a temporary position, retention of professional observers would not be as formidable a challenge as it is now. Establishing a cadre of professional observers will prove beneficial to fishermen, managers, end-users, as well as observers. The creation of federal observer positions will remove much of the uncertainty I have described, providing continuity for observers across the board, and providing a more established career path.

Poster 16, Paper 142: Increasing observer job satisfaction through career services

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For many people, the fisheries observer job is a stepping stone, a way to gain valuable field experience and build their resume. After fulfilling their contracts with their observer provider company, many observers begin to think about potential next steps in their careers. At the Fisheries Sampling Branch (FSB) we provide support to observers on many levels, including training, incidents, and data quality. In addition, there are opportunities for providing support to observers as they decide to transition out of the program to further their careers/schooling. I am interested in providing observers with a resource that would aid them in this transition. This resource, to be accessible via a web portal, would include features on former observers and the career paths they have taken, and how they have utilized their experiences and skills gained from observing. Observers would be provided with a list of fisheries/science related job sites, information on schooling opportunities, as well as contact information for office staff, former observers, and other collaborators who observers could reach out to for additional support. Job satisfaction is significant both to FSB and to the observer. By connecting observers and their skill sets with job opportunities, we can highlight the value of observing and increase overall satisfaction within the program.

For the International Fisheries Observer and Monitoring Conference this summer, I'd like to present a poster that features former observers and the paths they have taken, describes the career resource, and shows how it could be migrated to other observer programs.

Poster 12, Paper 33:The Evolution Of Effective Training Techniques In The At-sea Hake Observer Program (A-shop)

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What makes an observer training effective? How do trainers keep the observers engaged in learning the WHY of their job, as well as the HOW to do it? How do we make the training as interactive and informative as possible?

In discussions about how to make our training more effective, we kept coming up against time as the constraining factor. When we realized time was what was limiting us from improving our trainings, we made the big step of expanding our training from 3 days to 4 days.

Expanding our training to 4 days has allowed us to incorporate more interactive training activities, as well as expand training on health and safety topics. Developing hands-on training exercises simulating real-life sampling scenarios and using actual gear gives the observers a clearer picture of what they will encounter and allows the trainers to clear up confusion before data even begins to be collected. Communicating the WHY is also critical, to give observers a vested interest in collecting the highest quality data. Having guest speakers who are the actual data users serves the dual purpose of demonstrating the WHY, as well as breaking up some of the requisite sitting and listening portions of training. An effective observer training is the vital first step towards our end goal of sustainable fisheries management. It is our responsibility as trainers to continually strive towards providing observers with the best information and tools to meet that goal.

Poster 14, Paper 44: Exploring the relationship between long-time priors and newer observers: How can we make the most of experience?

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Throughout his or her career, an observer will venture through a rigorous evaluation process - beginning with an intensive training class, then resuming in the field through a mid-cruise debriefing and inseason advisement. The process will end with a debriefing interview - then resume when the observer returns and takes an annual briefing class. These evaluation methods represent the formal channels for observer development. An observer will also seek informal channels for development through a well-experienced prior observer.

These informal development opportunities are worth exploring. Especially the unheralded role of the long-term prior within an observer program. Newer observers may find training materials too broad, dry, or simply not detailed enough to be of much comfort in a specific situation. Long-term priors can help newer observers in any facet of observing from packing and/or travel skills, streamlining the sampling workload, efficiently recording data, effectively communicating with crews, to general well-being in working and living on fishing vessels. The amount of exposure newer observers may have to well-experienced priors throughout their careers may very well prove to be the difference in whether they feel confident as professional fisheries observers collecting data and monitoring compliance. In the long run, this exposure may help decrease turnover rates and improve data quality for observer programs worldwide.

The North Pacific Groundfish Observer Program has 24 observers with at least 10 years of experience. In playing an informal guidance role within an observer program or an observer provider's corps, it is important to note that the long-term prior may find it more beneficial to play a mentoring role rather than a management role in working with less experienced observers. The difference is setting a good example for the long-term prospects of the observer profession. Long-term priors can help foster an atmosphere that allows younger observers to embrace the job/lifestyle of observing and become a more mature, professional, and effective observer - teaching not only the job but a love for the job.

Poster 11, Paper 27: Training Strategies For Retaining Observers And Minimizing Turnover

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Abstract. Development of a robust observer training environment is contingent upon the success and professional growth of the observer as well as the program that supports them. This unification between observers and the program plays a vital role in establishing a lasting working rapport, thus better ensuring observers have a fulfilling experience, return for subsequent contracts, and have the opportunity to grow professionally. In the North Pacific Observer Program constructive feedback is imperative to stimulating said growth of the individual observer and moreover promotes the continual improvement and evolution of the program. From the observer's initial training forward, multiple forms of feedback (e.g. Training evaluation form, post debriefing survey etc.) are consistently provided to ensure the materials used in training are current and tailored to address the specific challenges that observers may face over the course of deployment. This process of providing feedback is carried from the training environment into the field via in-season management. This near real-time communication allows the observer to enquire about sampling, receive constructive feedback about collected data, and address safety concerns. Following their deployment, observers are provided an opportunity to sit down with an observer program staff member, all of which have previously observed, and get a chance review their methodologies and catalog the challenges they faced during the course of their contract through a standardized debriefing process. Information is gathered and simultaneously evaluated to better ensure it can be incorporated into program updating thus promoting a circular flow of information. Throughout this presentation you will gain insight on the outlined fundamental practices of the North Pacific Observer Program which have proven to increase transparency throughout all program processes. This limpidity allows the program to foster trust and bestow confidence in the observers being trained. When observers play an active role in this process they are far more inclined to complete multiple deployments, exhibit strong work ethic, and continue to grow professionally throughout their career. By doing so, the observer remains connected to their cause, and as a result, help promote their own success as well as the success of the program.

Poster 13, Paper 36: Building Community in the West Coast Observer Program Through Outreach

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When the Catch Share program was implemented in 2010, the West Coast Groundfish Observer Program (WCGOP) observer numbers rose from approximately 40 to 100+ in less than six months. This altered the WCGOP staff-observer dynamic. What was a close-knit community became a collection of photos and email addresses.

This shift was a challenge. Observer feedback indicated observers didn't feel as connected to the WCGOP. This lowered both observers' and staff morale. It also jeopardized high observer retention goals and our strong observer-to-program relationship.

Recognizing this as an opportunity, we developed *Word on the Waves*, a quarterly newsletter targeting active WCGOP observers and staff. Its purpose is to keep observers informed of Program happenings, current industry events, and NOAA research. We also highlight the observers, their activities, accomplishments, and contributions to the Program.

Why

- **Controllable**. We wanted to ensure the publication reached active observers and our stakeholders.
- **Fits observer lifestyle.** The PDF format is downloadable to all devices and ensures a quick upload.
- **Sustainable.** It doesn't require constant maintenance. The time investment is shared among WCGOP staff and observers and is compatible with our work load.
- **Promotes collaboration.** Each issue is a group project. This strengthens staff-observer connections, improves relationships and facilitates communication.

Content

- Observer Spotlight: front page article showcasing an outstanding observer.
- From the Program: message from Jon McVeigh, Program Manager.
- From the Galley: recipe by John LaFargue, California Coordinator featuring seasonal seafood.
- Program Snapshot: quarterly summary of fishing and observer activity.
- Fisheries News: compilation of current events and news pertinent to observers.
- Science Article: interesting research or trends using observer data.
- Observer Piece: observer contributions to the newsletter; tips, tricks, port overviews.

Bonuses

- Outstanding achievements and efforts are publically acknowledged.
- Observers' contribution to fisheries management is visible to upper management.
- Observers see how their data are used.
- Helps observers get to know each other.

Achievements

- June 2016 is our 12th issue.
- Winter 2016 had a record number of observer contributions.

Future Plans

- Continue quarterly publishing.
- Increase observer participation.

Poster 20, Paper 171: Investment Opportunities: Determining Factors Which Result in the Long-Term Retention of Fisheries Observers

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Fisheries observers play an integral part in the collection of real-time field data used by thousands of people in both industry and research alike, but are often relegated to the outskirts of both the scientific and the fishing communities. At the best of times, they are seen as the future of the fisheries science world - each putting in their time in the field before moving up into more scientifically rigorous programs and careers. At the worst, they are considered easily-replaceable, "dime a dozen" employees with little impact on the fisheries world at large. This second mode of thinking is very damaging to both the regulatory programs and the industry that rely on the observers whom are on the front lines of fisheries management. As observer programs recruit, the view of the position as impermanent is inevitably communicated to prospective observers, creating a self-fulfilling prophecy of temporariness. With such high turnover rates, training must be provided again and again for new observers, wasting money, time, and resources that could be allocated to other areas. In addition, observer programs continually lose a valuable accumulated wealth of experience and knowledge, as well as the higher quality data that follows. In order to determine a way to mitigate this seemingly unavoidable observer attrition rate, a series of questions pertaining to observer job satisfaction, hiring practices, performance, compensation, contractor support, and other professional opportunities was developed and disseminated among current and prior observers of different levels of experience. The anticipated results of these interviews will be a comprehensive list of reasons that observers continue in the field or retire, and insight into the potential aspects of an observer program that would successfully create a communicative support system for long term observers.

Poster 18, Paper 163: Survey design to identify incentives and disincentives to continue as U.S. fishery observers

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NOAA Fisheries utilizes observers to collect information on catch, bycatch, fishing efforts, biological characteristics, interactions with protected species, and socioeconomic information from U.S. commercial fishing and processing vessels. Observers are usually the only independent data collection source for fishery-dependent data and are crucial in fishery management.

The National Observer Program (NOP) is conducting a survey of past and present fishery observers in order to investigate incentives and disincentives for remaining an observer and to identify their subsequent career choices. The survey will collect background of observers, including their demographic information, educational level, history of observing and their plan for future career path. This information is important to classify perceptions of observers with different gender, age and educational degree. And it could offer a quantitative estimate of the importance working as an observer to their career path. The major component of survey is intended to identify the level of satisfaction working as observers relating with observer program, provider company, and captain/crew. More information regarding their experience towards international fishery and regional program will be included to provide a comprehensive understanding of observers' experience.

The survey results will be used by national and regional program managers to evaluate current observer provider contract requirements with an aim to increase observer retention. This information is needed to support the Agency's conservation and management goals, to strengthen and improve fishery management decision-making, and to satisfy legal mandates under Federal laws. Improved retention of qualified and experienced observers is expected to reduce training efforts and costs, and improve data quality. During the conference, observers will be encouraged to register to receive an internet link to the survey.

POSTER

How Can Fisheries Observers Improve The Quality, Diversity And Use Of Fisheries Dependent Information?

Poster 21, Paper 11: Pacific salmon identification: Are we doing enough?

Roy MORSE[1]

[1] **NOAA**

Pacific salmon support economically and culturally important fisheries in the Pacific Northwest and Alaska. In order to protect salmon populations, several fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska have annual by-catch limits for Chinook salmon. These salmon by-catch limits can result in the closure of fisheries in the Bering Sea and Gulf of Alaska regions. The North Pacific Observer Program (Observer Program) monitors and collects data on Pacific salmon by-catch, including counts, weights, lengths and species identifications, to assist with implementation of by-catch limits in the region. Observers in the Alaska region may encounter five species of Pacific salmon, and their identifications can be challenging due to interspecific similarities in life histories and identification characteristics. In order to effectively manage by-catch caps, correct identification of salmon is critical, so the Observer Program has implemented data quality protocols to assess and verify observer salmon species identifications. These protocols include a species identification form, which must be completed by the observer upon encountering each new species, and scale collections. Completed forms and scale samples are reviewed during debriefing to assess the accuracy of salmon identifications. Some observers also provide photo documentation of salmon specimens, which can aid in identification if the completed species identification forms and scales are inconclusive. Evaluating the challenges of identifying salmon species in the field and processes that are used to assure the high quality of the data is necessary.

Poster 22, Paper 38: THE EVOLUTION OF SCIENTIFIC SAMPLING IN THE NORTH PACIFIC

Kayla UALESI[1]

Brian MASON[2]

[1] Pacific States Marine Fisheries Commission- NOAA, [2] North Pacific Observer Program

Observer data is used to estimate total catch and manage fisheries in season as well as to establish fishing quotas for future seasons. Because high quality data is needed to meet these needs, a science based approach to random sampling in the North Pacific is necessary. Sampling protocols in the North Pacific have been improving incrementally as is necessary in the every changing commercial fishing industry. In 2008, the North Pacific Observer Program (Observer Program) moved from recording one large random sample for each haul, to collecting multiple definitive samples throughout a haul. With this change, observers collected samples that provided a better representation of the entire catch yet there was still no way to clearly define how these science based samples were actually being collected. In 2010, the Observer Program took strides towards clearly defining how samples were collected by establishing sample unit codes. When the observers began documenting how each haul was being sampled using these sample unit codes, data users were able to better extrapolate total catch estimates and manage fisheries inseason with more precision. In 2016, the Observer Program recognized that observers were still facing difficulties on certain vessel types where it was more challenging to define a sample unit. In order to rectify this issue, sample units have been clarified even further by taking a more scientific approach to the sample methods that have been in place since 2008. Data collected using this new approach is more scientifically sound and data users can better understand the methods used by fisheries observers who execute rigorous sampling designs aboard commercial fishing vessels in the North Pacific.

POSTER

Reducing Risk In A High Risk Job.

Poster 30, Paper 125: Classifying Hazards to Observers: Analyzing Current Training and Suggestions for Improvement

Patrick CARROLL[1]

[1] iap world service / noaa fisheries south east Galveston

There are three types of hazards encountered by offshore observers: Nature, Crews and Illness/biohazards. The first of these, referred to as nature would be the ocean itself and the ensuing unpredictability of it as well as boats and vessels. Current observer training address this hazard quite well with a third or more of their initial training time devoted to it. Personal flotation devices, rafts, epirbs, signals and firefighting all covered.

The second type of potential hazard encountered by Observers is the Captains, crews and owners of the vessels. Observer training in this area is lacking, and is mostly left to the individual observers, though some programs provide conflict resolutions sessions that are of unknown usefulness. The backgrounds of most observers and crew are radically different. Some effort should be made in training observers to recognize potentially dangerous interpersonal situations and how to deal with them.

The third type of hazard observer's encounter is illness, bio hazards, and lack of immediate access to medical care. This class of hazard is addressed in certain training programs as some, such as Methicillin-resistant Staphylococcus aureus (MRSA), have become quite prevalent resulting in hospitalizations. Cardiopulmonary resuscitation (CPR) is also required, but observers are not trained to recognize serious health situations, nor is how to deal with them, and often there no standard course of action. One suggestion is to provide observers with standardized first aid kits including some sort of antibiotics. Another is to provide observers with sufficient health insurance

Poster 28, Paper 104:Observer Safety: Communication and Eduction

Katie HERRERA[1]

[1] **Riverside Technology, Inc**

Two areas that can greatly affect safety at sea are communication issues and levels of safety education. Communication between a company and their observer, an observer and their captain and crew, and the vessel with land based emergency responders such as the Coast Guard are connections that need to be established and maintained. Educating our offshore community on the safety measures directly tailored to life at sea would also improve safety levels. As a former observer, I am now tasked as an Assistant Observer Coordinator with the Pelagic Observer Program and have seen, first hand, the gaps in a system that can be greatly improved. This display will discuss ways to bridge those gaps in communication and safety by addressing ways to improve upon areas such as: communication breakdowns at sea, outdated communication equipment used by vessels and land based operations, and safety resources and training designed for both observers and captains to survive and strive with only basic offshore tools. Safe environments are made and upheld when everyone is an active and engaged participant.

Poster 25, Paper 40: Observer Safety on the U. S. West Coast, Vessels 18 to 680 Feet in Length

Thomas HOLLAND[1,2]

Scott LEACH[1,2]

[1] **NOAA Fisheries,** [2] **Pacific States Marine Fisheries Commission**

Preparing observers to board vessels that range from 18 to 680 feet, requires safety training that is both broad in scope and yet specialized to the size vessel observers are likely to encounter. On the U.S. West Coast, observers are deployed by the West Coast Groundfish Observer Program (WCGOP) on small catcher vessels (18-98 ft), while the At-Sea Hake Observer Program (A-SHOP) deploys observers on larger at-sea processing vessels (256-680 ft). The catcher vessel training takes place in Newport, Oregon while the processing vessel training is in Seattle, Washington

The challenges and conditions present on at-sea processing vessels compared to catcher vessels is quite different. Observers on at-sea processing vessels have trips averaging 21 days, where they will conduct their sampling below-deck in the vessel's factory. Observers on catcher vessels take trips ranging from 1 - 25 days, where sampling will occur on the open deck, in close proximity to net reels, winches, longline gear or pots. Unlike at-sea processors which only fish with trawl nets, catcher vessel observers can encounter multiple gear types including, rod and reel, trawl, troll, pot and longline. Despite these differences the two training programs have many similarities and overlap on drills conducted and topics covered. Safety issues present on both catcher and at sea processing vessels trained in both programs include: fire safety and hands-on firefighting, signals and hands-on flares, flooding drills, man overboard drill, abandon ship drill, donning an immersion suit, swim positions, righting a life raft and familiarization with both observer program issued and vessel safety equipment. The A-SHOP program also includes training for hazards found in fish processing factories and larger vessels, while the WCGOP trainings focus on smaller vessels and their inherent dangers. An outline of the similarities and differences presented here are an example of the dangers observers face and how to best prepare for them.

Paper 51: Bed Bugs: Pest or Potential Marine Safety Hazard

Kenneth KEENE[1]

[1] **NOAA SEFSC**

Bed bugs (*Cimex lectularius*) have been a nuisance in residences throughout almost every region of the world and in all 50 U.S. states. Fishing vessels are not exempt from bed bug infestations, which add a new dynamic to pest control due to the marine environment and a fishing vessel's nature of being transient. The aforementioned issues pose a problem to all who inhabit bed bug infested vessels, either permanently or on occasion (such as an observer). Seemingly insignificant at first glance, especially when dealing with other potentially dangerous offshore conditions, a constant, 24/7 pest interaction on a confined vessel eventually poses a question: Does this pest affect safety and health? This paper/poster/presentation will research how bed bugs may affect human behavior, transmit disease, and cause potential health and safety risks to those on infested commercial fishing vessels while also describing signs of bed bug infestations and other useful facts and information.

Poster 27, Paper 100: Reducing risk in a high risk job.

Lauren KREGEL[1]

[1] **AIS Inc**

With being a North Pacific Observer (NOP) there is danger at every turn. We constantly have to be watching our step and expecting the unexpected. Every boat you get on though you learn a little more each time.

National Marine Fisheries Services (NMFS) observer training program prepares you really well. They go over scenarios that may happen so that you know what to do when they arise. Their instructors are hands on and we work with gear that we will encounter in the field. We are prepared the best anyone can be for an ever changing profession.

I believe that being proactive with captains is a major tool into minimizing injuries while aboard. Always making sure the captain knows why you are there and what your job is seems to make everything go a lot more smoothly. Talking with the captain and crew about where to work on deck and where not to step helps prevent mishaps. The captain and crew know the boat and where the safest places on the boat are and where hazards can be, which means having an open communication is key.

I believe that you can never truly be one hundred percent prepared for a boat that you have to get on, because nothing is ever certain with being an observer. You can't predict what is going to happen with the weather or the boat, but you can plan and be educated to the best of your abilities.

Poster24, Paper 37: NMFS Safety Program Review

Richard KUPFER[1]

[1] **NOAA / NMFS**

The National Oceanic and Atmospheric Administration Fisheries Service (NMFS) is mandated with ensuring the safety of the fisheries observers it deploys throughout the United States. Observers are deployed on commercial fishing vessels in 7 regions from arctic to tropical waters and all conditions in between. Though NMFS has been able to standardize some of its training and safety policies, differing practices have evolved in each region in response to local conditions. Review of the various risk mitigation tools in use, as well as their impact to ensuring safety, is critical to NMFS meeting its mandate.

Recognizing the variety and evolution of practices used in an ever changing safety environment, NMFS is undertaking a new systematic approach to evaluating its own safety practices and policies, and their impact on observer safety. To accomplish this, NMFS plans to evaluate every identifiable factor that influences observer safety and consider those factors to be the individual components of a "Safety Program". This holistic approach seeks to acknowledge a Safety Program as the sum of its parts so that it can be managed as whole rather than as separate components. This paradigm shift in the way NMFS regards safety will evaluate the relationship of all the factors that can be controlled to mitigate risk to observers, and to identify any factors that cannot.

An independent external evaluation by a team of experts will review every observer program throughout NMFS and observe their policies in practice. Regional, national, and international regulations will be evaluated on their impact to regional safety programs. The reporting and tracking of safety issues, at all levels, will be assessed for efficacy and utility in identifying trends for the adjustment of risk mitigation tools. Safety equipment will be compared with industry and Coast Guard standards as well as their applicability to observer duties, and emergency plans will be evaluated. The resulting review will identify the strengths and weaknesses of NMFS current Safety Programs, help prioritize needed changes, and equally important, help develop tools for continual process monitoring and self-evaluation.

Poster 29, Paper 117: Timeline and Lingering Questions Regarding the Disappearance of a Transshipment Observer

Elizabeth MITCHELL[1]

[1] **Association for Professional Observers**

Almost a year to the day, the observer community and observer program managers were shocked and heartbroken by the September 10, 2015 news of the disappearance of our dear friend and colleague, Keith Davis, a transshipment observer on assignment aboard an IATTC transshipment vessel. Keith chaired the Observer Professionalism Working Group (OPWG) for many years and was a former board member of the Association for Professional Observers (APO). He helped draft the International Observer Bill of Rights (IOBR) and Codes of Conduct for Responsible Observer Programmes - Health and Safety (CCROP-HS) and Stakeholder Responsibilities (CCROP-SR), which was presented at the 7th IFOMC in Chile, 2013. He had an unwavering commitment with seemingly limitless energy toward improving the profession of observers and was instrumental in elevating the level of observer participation at this conference. Panamanian authorities conducted an investigation into his disappearance but arrived at no conclusion regarding his fate. US authorities continue the investigation, with some of Keith's belongings still in their possession. Keith's disappearance sent rippling trepidations throughout the observer community and many remain without closure. In the days following this shocking announcement there was some confusion relating to his disappearance. I will discuss the timeline, known information and lingering questions that remain since the days and months after his disappearance that may help inform and garner support for continued investigation. I will also discuss the vulnerabilities of observers highlighted by this tragedy and outline possible changes needed to protect them and their ability to do their job.

Poster 26, Paper 77: Conducting effective drills during Observer Safety Training: Building muscle memory and a strong safety culture

Adriana MYERS[1]

[1] **North Pacific Observer Program, FMA, NMFS, NOAA**

"Luck favors the prepared". Commercial fishing is still ranked as one of the deadliest occupations both nationally and internationally. Among the many challenges fisheries observers face when working aboard commercial fishing vessels, safety is the primary focus. The North Pacific Observer Program assumes the responsibility to best prepare observers to be safe at all times while at sea.

All fishing boats are subject to an inherent amount of danger and it is crucial that everyone onboard receives the proper practice to know how to respond to an emergency. The United States Coast Guard requires commercial fishing vessels to conduct hands on safety drills once every month. However, not all fishers receive adequate training. Safety drills are one of the most efficient ways to practice response plans and ensure that everyone on board understands and demonstrates their preparedness in an emergency.

Fisheries observers in the North Pacific Observer Program assigned to fishing vessels that are required to carry an observer at all times are more likely to participate in emergency drills. However, based on observer data. fishing vessels that only have observer coverage during selected trips rarely conduct safety drills while the observer is on board. On these vessels, observers do not have the opportunity to practice emergency plans with the crew and assess crew preparedness. Since drills are essential to keeping our observers prepared in case of an emergency at sea, all our trainings at the North Pacific Observer Program incorporate safety drills. These drills require observers to work in teams with a variety of exercises, focusing on the roles the observer would be expected to fulfill in an actual emergency. Practicing drills on a regular basis as part of the training program builds muscle memory which is an excellent tool to condition the body on how to properly follow the seven steps of survival and be prepared to respond adequately in a real life emergency. Drills promote a strong safety culture among our fisheries observers who learn to feel responsible for their own safety and pursue safety practices on a daily basis to minimize risk.

Poster 23, Paper 21: An Analysis of the Current Bed Bug (C. lectularius) Infestation Occurring in the Hawaii-based Longline Fleet and its Effects

Jennifer SCHULTES[1]

[1] **Pacific Islands Regional Observer Program**

Abstract:

This presentation will depict the current state of the bed bug (C. lectularius) infestation occuring within the Hawaii-based U.S. longline fleet. Through an analysis of NOAA historical records, extent and pervascity of the infestation will be determined. The presentation will also summarize the qualitative effects an infestation can have on work place safety and data quality. Finally, It will theorize potential strategies for managing an infestation from within a vessle and the fleet as a whole

POSTER

Can Observers Effectively Perform Scientific AND Compliance Functions?

Paper 165: Observers and Compliance Issues

Matthew CUNNINGHAM[1]

[1] **NEFSC/NPGOP/APO**

Collecting data on compliance issues has always been one of the parts of the job that observers have to balance delicately. Our ability to collect unbiased data can be directly affected by compliance issues we encounter on board vessels. Reporting of issues such as harassment and marine pollution (MARPOL) violations are handled quite differently depending on the observer program involved.

The vast majority of observers started in this field to be a biologist. The expansion of observer responsibilities in reporting violations makes observers feel more like a law enforcement officer than a research biologist. When observers are required to report violations at sea, the fishermen know this. As fishermen and observers see violations occur, tensions can and do build. Fishermen often see certain violations as unavoidable and any incidents can end up being seen as an attack on their ability to make a living. This can easily be blamed on the observer and put us in a dangerous situation. There is already a system in place that should be handling compliance issues. With observers being deployed throughout the fleet, it is easy to see them as the first choice to deal with violations. Observers are the most visible government representatives to the fishing industry. We are also the least trained to handle large compliance issues. Observers are alone on board vessels at sea and have no law enforcement training. Compliance issues should be left to the law enforcement side of the government. National Oceanic and Atmospheric Administration (NOAA) law enforcement and the coast guard have an established protocol and training to handle these issues. Increasing these organizations scope and visibility will be the best way to monitor compliance issues. To put this burden onto observers will have a direct effect on our ability to collect unbiased data and can endanger the observer.

Poster , Paper 134: Multi-use observer data allows observers to perform scientific and compliance functions.

Alicia MILLER[1]

[1] **National Marine Fisheries Service, Alaska Regional Office**

Data collected by observers deployed on vessels and processors participating in the diverse groundfish and halibut fisheries of the Bering Sea and Gulf of Alaska are used by scientists, fishery managers and fisheries enforcement. Many data points collected by observers are multipurpose; a case study demonstrates how observer data are used for scientific, fishery management and compliance monitoring in the North Pacific.

POSTERS

What Are The Latest Technology Trends For Fisheries Monitoring Programs?

Poster 39, Paper 65: Applying Technology Trends To Fisheries Observing And Monitoring: 3D Printing

David CHANDLER[1,2]

[1] NOAA Fisheries, FOS, [2] Saltwater Inc.

Rapid digital manufacturing and 3D printing is a growing technology that, like other industries, fisheries observing and monitoring could take advantage of. 3D printing has never been more accessible than it is today. There are numerous desktop printers that will print quality prototypes and working end products right in the comfort of one's home or workplace. There are also service providers with industrial grade printers where one can send in their designs to be printed. One thing I have noticed about being an observer is the use of general tools and equipment in a specialized field. With 3D printing, observer programs can adapt to their unique conditions and requirements, designing and creating their own custom tools specific to the job at hand, making data collection more efficient and accurate. Electronic Monitoring (EM) is becoming increasingly used for applications where it is difficult or impossible to place an observer. 3D printing has vast potential with EM applications. One could look at each individual vessel or scenario and create whatever they would need to get the job done. Camera housings could be made custom to the camera being used and attach wherever they are needed on the vessel. Replacement and modification can be done in-house and immediately. No waiting for processing, production, or shipping. The beauty of 3D printing is one can get what they need when and how they need it. Having observed with the North Pacific Groundfish Observer Program (NPGOP) and At-Sea Hake Observer Program (A-SHOP), I've seen many ways 3D printing could be incorporated. I designed, printed and tested an otolith collection toolkit for my particular location and duties. Multi-purpose custom lids for the sampling baskets would be an improvement over the ones used now. Material and models can be made to help demonstrate concepts during training. These are just a few ideas. Imagine the possibilities when applied throughout all observer programs. This presentation will cover the process from design to production and use of 3D printed items for fisheries observing and monitoring. The otolith collection toolkit will be showcased as an example.

Poster 32, Paper 28: Innovations in Technology for Use by Observers and Observer Programs

Bubba COOK[1]

[1] **World Wide Fund for Nature**

The World Wide Fund for Nature (WWF) views innovations in technology as one of the key components to addressing global challenges in fisheries management. Rapidly advancing technologies in the fields of satellite technology, electronic reporting, and cloud computing hold immense promise for improving the ability of fisheries professionals, including fisheries observers and observer programmes, to more economically and efficiently perform their duties in broad expanses of ocean in remote areas with limited infrastructure. Many technologies, such as electronic reporting platforms for observers, could vastly improve the quality, utility, integrity, and reliability of information used to make fisheries management decisions as well as better ensure the safety and security of observers at sea.

On March 3-4, 2016, WWF held the second Monitoring, Control, and Surveillance (MCS) Emerging Technologies Workshop in Auckland, New Zealand, with over 130 participants representing 30 countries and over 20 technology providers. This workshop connected leading technology providers with fisheries professionals working throughout the world in a forum that offered an opportunity for technology providers to fully understand the unique circumstances facing regional fisheries authorities, allowed those providers to showcase potential technology solutions to those challenges, and, in turn, allowed regional fisheries authorities to assess the feasibility and practicability of those technologies. This presentation would briefly report the conclusions and outcomes from this workshop and how some of the innovative technologies addressed at the workshop could help support the goals and objectives of observers and observer programmes.

Poster 31, Paper 23: Electronic Monitoring to support transparency and Efficient Management for Long-term sustainable fishing

Gonzalo LEGORBURU[1]

Javier DE LA CAL[2]

[1] **Satlink**, [2] **Satlink SL**

Satlink S.L. is an international group based in Spain with offices in Fiji, Seychelles, Vigo and Ecuador. With almost 25 years providing satellite solutions and with extensive experience in the fishing industry, Satlink has reached a leading position in the market and a well known name based on the quality of its products and services.

Among Satlink's wide portfolio where should be included VMS solutions and Satellite buoys for purse seine and longline tuna fishing, Satlink has developed the "Satlink SeaTube" which is a powerful electronic monitoring system designed to observe, cover and post-analyze all the fishing activities of the vessels. The SeaTube system is fully configurable to address the requirements of fishery authorities and vessel owners. It is a great tool to prove the authenticity of fishing reports based on videos recorded with an automatic date/timestamp as a non removal watermark. Vessel surveillance and the capability to watch live video are other main features of the system. The SeaTube system consists of a number of HD cameras installed onboard the vessel, a Satlink video server (NAS/NVR), and a VMS system with preconfigured EEZs. Videos of fishing operations are stored onboard in the Satlink SeaTube rack and are encrypted. Videos are later extracted locally from the encrypted HDD for analysis ashore by the Observer Program with a Satlink View Manager analysis tool.

For the analysis and review of the videos, Satlink works together with Digital Observer Services (D.O.S.). DOS is an independent consultancy firm whose professionals are biologist with wide experience as onboard fishing observers. DOS analyzes and certifies the Purse Seine and Long Line fishing activities based on HD video reports and tailor made software being all procedures MRAG certified as ISSF accomplish.

Satlink/DOS have been involved in different world wide projects with private companies, NGO's and Fishery agencies. Some of the projects have been ABNJ Ghana and Fiji, 17 Purse Seiners and 50 Long Liners respectively, Forum Fisheries Agency with 3 Long Liners or Albacora with 18 Purse Seiners and 12 suppliers.

Satlink is, since 2016, the only Inmarsat Tier One distributor specialized in the Fishing Industry worldwide.

Poster 73, Paper 61: Back Deck Tech: Technology enhanced data collection in the West Coast Observer Program

Jason EIBNER[1]

[1] West Coast Groundfish Observer Progam (WCGOP)

In the midst of program growth and expansion the West Coast Groundfish Observer Program (WCGOP) remains dedicated to producing the most accurate and timely fishing information/ analyses possible to inform industry and regulatory entities alike. Recent WCGOP projects utilize new and updated technologies with the goal of achieving more accurate and efficient data collection/ processing to decrease data turnaround time. In Jan. 2015 all WCGOP observers began using hand-held scanners to create digital copies (PDF's) of the currently used paper data forms. The PDF's are then uploaded into the program database and transmitted along with their database entries for immediate dissemination to staff, coast-wide. This eliminates the lag time between data entry and submission, allowing the QA/QC process to begin as soon as the observer finds an internet connection.

Additionally, the WCGOP is investigating an electronic back deck data collection system that uses rugged tablets synced with various components to help collect/ document data and streamline the data collection process. This poster highlights how these projects adapt new technology for improved data collection and describes the benefits the WCGOP anticipates.

Poster 33, Paper 34: Electronic Data Collection Application for Dockside Observers

Kevin ROMANIN[1]

Taylor KERI[1]

[1] **Archipelago Marine Research Ltd.**

Prior to the introduction of the 1fish2fish™ app, dockside observers had to record all landing data from commercial vessels onto water-resistant paper notebooks, tally and triplicate forms to log and verify all fish unloaded by commercial fishers at the dock. All of the calculations were done manually on paper, many of which were time consuming and repetitive and in some cases had negative impacts on the vessels if they were done incorrectly. Some larger landings could see up to six pages of tallies, all of which had to be added manually. This was often done in less than ideal weather conditions (rain, wind, cold) with skippers being very impatient to get their data - they paid by the hour so they wanted observers to finish their calculations as quickly as possible. The 1fish2fish team came together to help make the dockside observers' lives easier and to meet the fishers needs in a timely manner. Together the project team - consisting of scientist, managers, programmers and data collectors - developed a top notch Android app called "1fish2fish™" that simplified the data collection process, increased quality and timeliness of data delivery and created new opportunities for further program development.

The project team took an idea and created a product that is user-friendly for non-technical users, time saving - both in real time and after the fact, eliminated the need for numerous (and sometimes complex) manual calculations and was a simple solution that exceeded the needs of industry. Together this team has ensured successful data capture of over 3,000 offload events over the last 3+ years in British Columbia's busiest fishing ports.

Poster 35, Paper 35: Data quality improvements through offline data entry and real-time error checking

Neil RILEY[1]

Jon MCVEIGH[1]

[1] **NOAA**

In 2011, Individual Fishing Quotas (IFQs) a type of Catch Share program, was implemented in the U.S. West Coast groundfish trawl fishery. The IFQ program requires reliable and timely observer data to be reported daily for fisher and management quota tracking purposes. To respond to this demand the West Coast Groundfish Observer Program (WCGOP) developed a new offline data entry application, created new data delivery procedures and improved data quality control measures to provide accurate data to end-users in near-real-time for the first time. The offline data entry is a mirror of the web based data entry application and which is stored locally on the observer's laptop. Offline data entry allows observers to enter their data at-sea while performing simultaneous data validation. This trip error checking process is accomplished through an Oracle Advanced Queue that executes a stored set of SQL statements that are run in the background. Real-time error checking allows the observer to correct all data entry errors prior to submitting their data. Once in port, data can be uploaded immediately from the laptop error free to the master database and therefore available for immediate delivery the review by WCGOP staff. The sync upload process allows the user to retrieve any database updates and new error checks. This poster depicts how offline data entry and real-time data validation has improved data quality and reduced delivery times for inseason data users.

Poster 36, Paper 53: Tips for transitioning from paper forms to in-the-field electronic recording

Eric SODERLUND[1]

[1] **International Pacific Halibut Commission (IPHC)**

The International Pacific Halibut Commission (IPHC) conducts an annual stock assessment survey comprising over 1200 sampling locations ranging from the southern Oregon border northward through the Bering Sea and along the Aleutian chain. It is one of the largest annual fisheries surveys in the world and generates reams of data recorded on a suite of paper forms. The three-month-long survey is completed at the end of August and the data are used for the current year's stock assessment which is released at the end of November. The time needed to keypunch and edit data after collection makes for very tight deadlines for the stock assessment. We developed an electronic data capture system to minimize the time between collecting data in the field and providing those data to the stock assessment team.

The IPHC contracts commercial fishing vessels to conduct the survey, thus opportunities to provide technical support are limited to infrequent emails and satellite phone calls. This places extra importance on the intuitiveness of the software and ability of a novice user to navigate all the features with limited practice, training, or support. To overcome the limited contact with users in the field, we employed a suite of user-centered design (UCD) methods, in which all stages of the development and design process place extreme importance on addressing the needs, wants, instincts, and limitations of the user. These practices help create a system that behaves how the user expects it to behave for the task at hand.

This presentation discusses the design and development process that we used to create our Entry at Sea (EaSea) system, including factors to consider when transitioning from paper to electronic systems, identifying and addressing data collection pinch points, planning for wet, slimy conditions on deck, designing tests to mimic conditions at sea, as well as specific UCD methods that benefitted the project.

Poster 41, Paper 129: Automated valves for measuring discards in Demersal fisheries

Ruben VERKEMPYNCK[1]

Michiel DAMMERS[1] **and Pieke MOLENAAR**[1]

[1] **Wageningen IMARES**

The Dutch large cutter fleet operating in the North sea consists of three segments: a beam trawl, twin-rig, and nephrops fishery. Cutters within this fleet differ in vessel length overall (23m-40m), engine power (223kw-1491kw), beam length (4m-12m), mesh size (70mm- >120mm), haul duration (1.5-6hours), catch quantity (up to 4000kg per haul), and catch processing time (30-45 minutes). The high quantities of catches per haul can only be processed in an efficient way through semi-automatic sorting and processing machinery on board of the fishing vessels.

These high catch volumes subsequently result in high discard rates. The beam trawl fishery is responsible for the biggest quantity of discards. In the period of 2011-2013, an average of 56000 tonnes per year were discarded. For the biggest beam trawl vessels discard rates reach up to 74%. These rates are exceptionally high and in the 'danger zone' where small uncertainties in the estimation have a disproportionately large effect on raised discard quantities.

In the Dutch discard monitoring programme the total catch volume per haul is estimated by the skipper and the scientific observer. There are several methods to quantify the catches of the cutter fleet in the North sea. These methods and their pros and cons are presented in this paper. The total volume of discards from each haul is then calculated by subtracting the weighed total landings from the estimated catch volume.

Several of these methods are evaluated here and analysis has shown that catch estimations vary substantially between methodsP. To prevent these inaccurate estimations a solution for the cutter fleet in the North sea can be found in the use of automated discard valves. A solution to accurately weigh all the catch that would fall through the discard valves. The valves are designed to fully automated measure quantities falling through the shaft. It opens and closed two separated programmed valves so that all fish, benthos and debris is measured in weight. The first sketches are fresh from the drawing board and funding is almost complete to make the first prototype.

Poster 40, Paper 84: Green Sturgeon-California Halibut Cooperative Project

Jason VESTRE[1]

[1] **West Coast Groundfish Observer Program**

Green Sturgeon-California Halibut Cooperative Project

Jason Vestre, Debriefer, West Coast Groundfish Observer Program (WCGOP)

The Southern Distinct Population Segment of green sturgeon is encountered in fisheries along the west coast. Many are encountered in the CA Halibut trawl fishery near San Francisco bay, but it is difficult to understand the impact of these interactions given limited knowledge of its effects on the species. This cooperative project, including WCGOP Observers, fisherman, California Department of Fish and Wildlife, NOAA scientists and observer program staff, is investigating the post-release impacts of green sturgeon encountered in the CA Halibut trawl fishery. Using satellite tagging technology, the cooperative is able to track post-release movements to evaluate effects of bycatch.

Poster 38, Paper 63: Enhanced technology in use within the United States commercial pelagic longline fisheries

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The Atlantic Bluefin Tuna, *Thunnus thynnus*, is an economically-important and highly targeted species worldwide and is currently listed as a species of concern by the United States National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries). This fleet has been monitored by the Pelagic Observer Program (POP), which collects and records a variety of environmental, effort, and biological data ranging from reproductive tissue, otoliths, muscle samples, liver sample, skin and dorsal spines. Since January 1, 2015, newly enacted regulations placed added technology on the United States commercial pelagic longline fleet to augment observer coverage, including enhanced Vessel Monitoring Systems (VMS) and electronic monitoring (EM) using video cameras. These innovations have added to the quality and robustness of data collected by the POP. NOAA Fisheries Office of Law Enforcement (NOAA OLE) plays an integral part in monitoring this technology, ultimately aiding in accomplishing management goals regarding the Bluefin Tuna. An overview of the implementation of and compliance for long-term regulations in this fishery will be presented, highlighting cooperation between multiple NOAA offices and the fishing industry. Observer coverage levels of the POP Program are compared to the VMS and EM data, highlighting the enhanced coverage obtained. The added coverage on the pelagic longline fleet provided by VMS and EM data would not be economically feasible using observers alone. The data POP observers obtain is irreplaceable and critical to assess the health of the fisheries, but the added technology used can serve as a cost-effective example for other regional fisheries and nations to use, helping monitor, manage, and conserve Bluefin Tuna worldwide.

POSTERS

What Are The Challenges With Integrating Electronic Monitoring / Electronic Reporting Technology Into Fishery Monitoring Programs?

Poster 49, Paper 60: Operationalizing Open-Source Electronic Monitoring Systems in New England Groundfish Sectors

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Ecotrust Canada, the Gulf of Maine Research Institute (GMRI), The Nature Conservancy (TNC) and the Maine Coast Fisherman's Association (MCFA) collaborated over 3 years to operationalize an Electronic Monitoring (EM) system as a means of obtaining accurate discard estimates of allocated species in the New England groundfish fishery. The overarching goal of the project was to use EM systems with video cameras to collect datasets comparable to those collected by the At-Sea Monitoring (ASM) program to verify self-reported data from fishermen. In 2015 video data was provided to National Marine Fisheries Service (NMFS) staff at the Fisheries Science Branch to facilitate audits of the data collection system and of our video reviewers. Video review summary data was provided to NMFS staff for comparison with electronic logbook (eLog) data submitted by harvesters.

Video reviewers identified individual fish to species and estimated lengths of individual fish using a measuring strip marked in centimeters that was adhered to the tray (gillnet) or the rail of the boat (trawl) and were converted to weights using approved length-weight relationships. We compared the following data between EM and logbook and the ASM/Observer program: date, time and location of hauls and ACE-managed discarded species weights and piece counts per haul.

Year 3 results speak to the quality and utility of data being captured by the EM systems and of the data analysis software developed for this project. The major cause of data loss came from poor performance with fish handling techniques by participants. The major cause of discrepancies came from identifying individual fish to different levels or groups based on different protocols.

Challenges experiences during our pilot program included: 1) developing new fish handling techniques and training participating fishermen to successfully adopt them; 2) developing a new monitoring tool without clear performance and design standards from appropriate regulatory authorities; and 3) the need to modify existing data transfer, management, and assessment systems currently being used by appropriate regulatory authorities.

Successes and lessons learned from this pilot are currently being used to help implement the use of EM systems as an alternative to ASMs in this fishery.

Poster 46, Paper 24: Marel Scale Bluetooth Data Acquisition

Eric BRASSEUR[1]

[1] **PSMFC / NOAA**

The West Coast Groundfish Observer Program is developing an electronic data collection system with the goal to completely eliminate paper data collection. To facilitate accurate weight collection we have asked Marel scales to develop a wireless Bluetooth module that can be incorporated into scales that use battery power. This will allow us to maintain the portability of our current data collection system and decrease the possibility of transcription errors while introducing a new data collection system.

The initial prototype caused a 20% increase in power consumption, reducing the battery life from approximately 80 hours to 64 hours. Further refinement is underway. I will present the results of testing the scale, including response time, distance the data can be sent reliably, ease of connection and potential upgrades.

Poster 53, Paper 128: Exploring a Cooperative System between Electronic Monitoring and Onboard Fisheries Observers in the Alaskan Groundfish Fisheries

Christopher Noren CHRIS NOREN[1]

[1] **Alaskn Observers Inc**

Increasing observer coverage in the Alaskan Groundfish small boat fleet coupled with limited space as well as improved technological advances have triggered a large industry push towards electronic monitoring (EM) as an alternative to onboard observers. Proponents of EM cite the increased costs of observers to the small boat industry and the potential for high quality, 24 hour data collection with cameras. Opponents of EM replacement of observers note that cameras can be more easily circumvented than observers, technological limitations for species identification, and the inability to collect specimen data. While both methods have limitations, a cooperative system between these two programs would allow for the highest quality data and management of the groundfish fisheries. This system would use EM as a passive monitoring system to gather overall catch data and provide evidence of fisheries violations while observers would focus more on specimen collection and biological sampling. In this system, EM would allow for large scale and constant monitoring of basic catch data and general regulatory compliance while observer coverage would decrease to alleviate the economic pressure on the small boat fleet and their role as compliance officers, which is a contentious issue on both sides, would also decrease. Observers would take on a role more similar to a field technician, collecting biological data such as otoliths and stomach isotopes that EM cannot account for giving NOAA fisheries biologists both high levels of catch data from EM and a deep pool of secondary resources to assess year classes and ecosystem regime changes.

My presentation would briefly touch on the current EM technology available as well as its advantages and limitations. Then present the pros and cons of both onboard observer coverage and EM before presenting a cooperative synthesis of both systems.

Poster 42, Paper 14: Development of an At-Sea Hand Held Data Transfer Application for Longline Observers

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[1] **Riverside Technology inc.,** [2] **NOAA / NMFS**

The NOAA Fisheries Service-Southeast Fisheries Science Center has three programs that monitor catch and bycatch in longline vessels in the western North Atlantic. To reduce the time and resources needed between data collection and data entry, developments of applications that facilitates the exchange of observer data between a remote version of the database contained on a computer and the central database are needed. This would allow an observer to enter and transmit data while at-sea from a vessel with email capability, using either an existing vessel monitoring system (VMS) or satellite transmission, which can reduce costs. Real-time quota monitoring especially under a catch share program is the end goal, but currently not available due to the lack of electronic reporting capabilities in the observer program. Preliminary development and testing of a tablet application found the screens did not load rapidly when the observer toggled among them and the iridium network for data transfer was insufficient. Further development began in 2015 with the goal of streamlining data entry and testing of several data transfer networks including the iridium, global star and Bgan network. However, many issues still need to be addressed before full implementation can occur. Learning from these trials, important developments will be presented and include necessary updates for the data application, utilization of technological benchmarks, and widespread troubleshooting.

Poster 52, Paper 119: Fishery Dependent Electronic Log and Remote Data Entry

Lara ERIKSON[1]

[1] **IPHC**

Since the 1920s, the International Pacific Halibut Commission (IPHC) staff has collected logbook information from the fishermen participating in the commercial fisheries for Pacific halibut in U.S. and Canadian waters. IPHC staff has also collected biological information and structures from Pacific halibut landed in these fisheries. IPHC fishery-dependent sampling data collection methods have been based on a pencil and paper technology throughout the majority of this time. With recent advancements in the field of ruggedized computing, the IPHC is exploring ways to integrate the new technology to enhance this data collection program. The primary impetus for this is to create a process that will eliminate or reduce the need for post-collection data entry and increase the efficiency of data editing. Consequently, the data will be provided to the end users (i.e., stock assessment and research scientists) earlier than in the past, allowing more time for data analyses. This process also provides greater precision, verification, and timeliness in the collected log data.

In 2015, an electronic tablet was provided to IPHC port samplers in each staffed Alaskan port and Bellingham, Washington, for entry of fishing data from the IPHC logbooks directly into the remote data entry (RDE) application. Samplers were tasked with entering data from as many of the logs they collected, as priorities and time allowed, during the course of their regular port sampling duties.

Modifications and enhancements to the application are still in progress. In 2016, RDE of log data continues to be a regular part of the IPHC port sampling program's log collection protocol. A review of the development, testing, and application of this electronic remote data entry system is provided along with detailed pros and cons, enhancements, accuracy assessments, and a path forward.

Poster 50 Paper 68: Open Oceans - How the digital sharing culture supports healthy fisheries

Jared FULLER[1]

Morgan WEALTI[1]

[1] **Saltwater Inc.**

Saltwater Inc. is an industry leader in the design and implementation of fishery and marine mammal observer programs, and an innovator in the use of electronic monitoring (EM) for data collection. The open-source movement, which promotes collaborative development of computer source-code by multiple independent sources, will likely be among the most transformative ideas shaping the 21st century. We believe that the establishment of *open standards* for onboard EM data collection systems, and the use of *open-source* data review software, are critical to the long-term success - and sustainability--of EM programs.

A key constraint to effective EM implementation is the cost of data review. Operational implementation of EM requires not only collecting hours of video and sensor data, but also the ability to efficiently extract from that data the meaningful information needed to manage a particular fishery. Without *open standards* that define data collection specifications of onboard EM systems, service providers will continue to collect data in formats that can be interpreted only by their own - often proprietary - review software. If clear, open standards were defined, data acquisition software would necessarily reflect those standards and the data collected by one service provider could be easily viewed using third-party software.

Saltwater is, and has been, committed to open-source software for EM data acquisition and review. We are pioneering the development of open-source review software and promoting the development and application of open standards. We believe that open-source software avoids the limitations and expense associated with proprietary code, encourages collaboration and innovation, and will speed the development of cost effective review solutions. An open EM ecosystem would allow for more flexible program design, and reduce redundancy and promote cost saving by encouraging collaboration. The end result is a more transparent, cost-effective, and innovative environment for data collection and fisheries management.

Poster 51 Paper 69: Humans and Technology - The two pronged approach to better fisheries monitoring

Morgan WEALTI[1]

Jared FULLER[1]

[1] **Saltwater Inc.**

Observer programs have expanded throughout the years as the pressures on our fisheries and oceans have grown and the demand for data has grown with it. Yet while the need for data has increased, with quotas being cut and monitoring costs being transferred to industry, there is an increasing need to find ways to collect that data more cost effectively. As in many fields, one approach is to find effective ways to use technology.

As technology has advanced in recent years, cameras, sensors, satellites and computers have resulted in new ways to collect fisheries data. Yet while the use of technology - especially electronic monitoring (EM)-- has picked up steam, observers and some observer providers have been leery of the shift.

Saltwater has been involved in the observer business since it's inception, and we are also innovators in the use of EM. Saltwater's experience as an observer provider gives us a depth of understanding that has helped define our approach to EM. Observers understand fisheries, data requirements, and day-to-day operations onboard a fishing vessel, as well as what it takes to work with representatives of both industry and government agencies. At Saltwater, observers - and former observers-- are at the heart of the design and implementation of our EM program. They work for Saltwater as EM technicians, data reviewers and program managers.

Saltwater's vision is not to take away observer jobs with EM, but to find ways to bring the skills of observers to the development and implementation of EM programs. Our mission is to provide high quality fisheries data, and we believe that the best approach in the years to come is to combine the skills and talents of observers with the benefits of technology, making the most of each of their unique contributions.

Poster 44, Paper 19: In Defense of Human Observers

Derek KUDA[1]

[1] **NMFS/TechSea**

At the last observer conference in Chile, I noticed many observers were concerned about being replaced by Electronic Monitoring (EM). My goal is to calm my fellow observers, appeal to the sensibility of decision makers implementing EM projects, and allow observer program managers to justify their program.

I have experience observing on a grouper longliner that was piloting EM with video cameras in Florida, and I saw the limitations of the multiple camera setup. In addition to collecting accurate catch data, I was able to tag (PIT and metal) a hooked sea turtle that I convinced the fishermen to bring onboard. Also, the fishermen had to toss released fish within in view of a camera. The cameras certainly missed seeing some fish, and definitely could not tag a turtle.

Why should fisheries observers be human? Human Fisheries Observers (HFO's) serve humans by being eyewitnesses, flexible, caring, diplomatic, promoting safety, helping, and teaching. HFO's provide first-hand experience and provide feedback to managers of issues and solutions. HFO's are able to adapt to field conditions and handle unusual events (specimen collecting, tagging). HFO's care about fisheries and fishers by listening to their concerns. HFO's are ambassadors and when they do good work they make their bosses, agency, and government look good. Some examples: Earning the respect of captains and fishermen by working hard, and providing assistance in rescues or emergencies. Also, they provide communication between fishermen, captains, and managers. HFO's model safety by wearing Personal Floatation Devices on deck and prompt fishermen to think of safety. HFO's help keep decks and galleys cleaner and safer by removing hazards and handing tools to fishers. HFO's teach fishermen by modeling proper behaviors like waste disposal, correct installation of safety gear, and even manners (saying: please and thank you). HFO's already deploy and maintain some EM (cameras, Go Pros, satellite tags). An android observer will never do what a HFO can do because it is not human and fishermen will not be able to relate to it. They are more likely to harass the android with practical jokes.

Poster 43, Paper 17: The Challenges and Lessons of Electronic Reporting in the Pacific Islands Regional Observer Program: Setting Goals, Determining Priorities, and Evaluating Feedback in Early Development and Testing

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[1] NOAA NMFS PIRO Observer Program

In September of 2014, the Pacific Islands Regional Observer Program (PIROP) began early development of an electronic reporting project with the following three goals: 1) to develop a mobile application to augment observer data collection; 2) to improve the timeliness and accuracy of observer data; 3) to reduce program expenses through the successful implementation of goals 1 and 2. Since that time, PIROP has successfully moved from early development to at-sea user testing with observers and program staff. Early user feedback has been promising, and PIROP is seeking to continue the development of the electronic reporting system.

The prevailing assumption is that transitioning to electronic reporting will be costly, and as such, funding will present the primary challenge toward implementation. However, while questions of funding are critical, the identification and mitigation of programmatic challenges during the early development of a project are equally important to achieving adequately operational systems. PIROP has identified the following programmatic challenges throughout the development and testing process: effective goal setting and prioritization, communicating program specifications and requirements to outside development teams, ensuring the quality of data, forming consensus amongst a multitude of program stakeholders, and meeting the requirements for data security, enforceability, and archiving. Additionally, the existing horizontal structure of observer program organizations contributes to a lack of centralized access to information, which can often impede results that conform to agency standards, and prevent projects from moving forward. (e.g. data encryption, chain-of custody, etc.).

PIROP has had early project success, in part, due to three strategies. Firstly, setting goals with achievable outcomes by clearly defining objectives and key results (measurable). Secondly, determining program priorities through ongoing outreach to stakeholders. Stakeholders' involvement during the developmental stages is essential in identify critical requirements that may otherwise prevent a project from moving forward. Lastly, evaluating user feedback through clearly defined metrics. Testing with real users in real environments produces a wealth of information concerning usability, functionality, compatibility, and reliability of a system. When properly executed through these strategies, testing will provide feedback that can steer development and eliminate uncertainty prior to implementation.

Poster 45, Paper 178: Electronic Monitoring trials in Fiji and Ghana – a new tool for compliance

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Under the Common Oceans Area Beyond National Jurisdiction (ABNJ) Tuna Project, implemented by the Food and Agriculture Organization of the United Nations (FAO) and support by the Global Environment Facility (GEF), the government of Fiji is implementing an Electronic Monitoring (EM) project on board it longline fleet, and WWF and the Government of Ghana are implementing an EM Project on board the Ghanaian tuna purse seine fleet. Both activities aim to test the possibility of using EM system as a tool for Monitoring Control and Surveillance in addition to the collection scientific observer data.

EM was deployed on board five Fijian longliners in September and October 2015, and 10 vessels are currently under deployment. Within the next 18 months, a total of 50 vessels will be equipped, which make this project the largest EM project in the world so far. In Ghana, the whole active fleet of 11 purse seiners are equipped since March 2016. In both countries, capacity was developed with the training of 17 staff from the Fijian fisheries department and 8 staff from the Ghanaian Fisheries Commission to review and analyse EM data collected during fishing trips.

So far, during the trips reviewed in Fiji, more than 130 sets for a total of more than 350,000 hooks. In Ghana, 27 fishing trips have been reviewed for a total of over 1000 fishing days. EM will allow Fiji and Ghana to add another tool to its Monitoring Control and Surveillance (MCS) toolbox, to ensure that vessels fishing in Fiji waters comply with international, regional and national requirements and to increase their observer coverage at a lower cost. However, progress need to be made to reduce the time needed to undertake review of the EM data, *i.e.* around 1/3 of the time of the trip.

Finally, business cases will be developed in both countries to see what are the different options to make EM a sustainable MCS tool in both countries.

Poster 48, Paper 52: Overview of the observed and unobserved data, and some aspects on the potential use of the electronic monitoring systems (EMS) in the tuna purse-seine fishery.

Marlon ROMAN[1]

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The IATTC was created in May 31st, 1949 in agreement between USA and Costa Rica to maintain the tuna populations in the Eastern Pacific Ocean (EPO). The IATTC Observer Program started in 1979.

The observers were assigned to purse-seiners greater than 363 metric tons carrying capacity (Class 6) to collect data related to fishing activities. Since 1992 observers from different National Programs started collecting purse-seine fishery data on board vessels class 6 vessels, and the observer coverage was nearly 100%. Purse-seiners less than class 6 are unobserved and comprise about 15% the tuna captures in the EPO, the tuna data is collected thorough unloading logbooks, but the majority of non-tuna data is not collected. In addition, the IATTC also keeps summarized data information from industrial longline fisheries. The tuna purse seine fishery occupies a vast portion of the EPO. This fishery catches tunas according to their association: sets on a free school of tunas, sets on tunas associated with dolphins, and on tunas associated with floating objects. The main species caught by this fishery is the yellowfin, the skipjack and the bigeye tuna. Several non-target species are incidentally caught by this fishery (bycatch). The IATTC observer database keeps data collected by observers since 1979. The focus of the data collecting was marine mammal involvement in the tuna purse-seine fishery and vessel activity. Along the years, new data variables have been incorporated into the database. The taxonomic resolution of the IATTC bycatch database has evolved from taxonomic group of individuals to identifications down to species. The potential use of the electronic monitoring systems (EMS) in the tuna purse-seine fishery is explored on fishing data collecting for vessels where the observer placement is logistically difficult as well as in class 6 vessels to back up the dolphin safe condition recorded by the observer for the tunas caught in sets associated with dolphins, or to validate the observer data and facilitate the government interpretation of possible infractions to the Agreement on the International Dolphin Conservation Program (AIDCP).

Poster 47, Paper 50: An integrated Electronic Monitoring and Electronic Reporting system (EMR) to be used on-board commercial fishing boats

Luke SZYMANSKI[1]

Rick USHER[2], Amos BARKAI[3], Greg HAMMANN[4] and Luke CURCI[1]

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Fisheries around the world are evolving toward greater collaboration and self-governance in response to directives for long-term sustainability, catch shares, cost recovery and environmentally responsible shing. These drivers, together with enhanced data encoding and storage, satellite vessel tracking and on-board monitoring technologies, are enabling an international effort to receive and process credible and verifiable sheries data supporting better management decision making.

Two electronic (e) technologies are central to this quest: On-board Electronic Monitoring using cameras and gear sensors (EM) and eLog Reporting (ER), in short EMR. While the underlining technologies of the two EMR core components are different from each other they are nevertheless essential for effective Monitoring, Control and Surveillance (MCS) of fishing operations, and for an informed management process. A team made of Olrac SPS (www.olsps.com), an International provider of eLog technology; Marine Instruments (www.marineinstruments.es),a global company which specializes in the development and manufacturing of marine electronics including vessel monitoring and tracking systems,; and AIS Inc. (www.aisobservers.com), a USA based fisheries observer service provider, represents a new direction in the development of fisheries eTechonology. Together Olrac SPS, Marine Instruments and AIS have combined their forces, technologies, and expertise in order to create one integrated EMR solution under the AFMOS (Advanced Fishing Monitoring and Observation Solutions) (www.afmos-usa.com).

This EMR solution incorporates the NOAA certified Olrac eLogbook technology, eEye "state of the art" on-board monitoring and vessel tracking systems and professional observer knowledge base to allow fishers and management authorities to cover all their compliance, commercial and scientific monitoring and reporting needs with a single integrated solution. The core vision behind the technical solution offered by the AFMOS team is that the on-board, electronic logbook will be the core, legal reporting tool, while the on-board Electronic Monitoring systems will be used, as an auditing tool by shore side observers to verify (to the extent possible) the data reported electronically by the fisher. For this solution to work, the authors developed a tightly integrated system and service model, the details of which are to be presented.

POSTERS

How Do We Observe And Monitor Artisanal Fisheries?

Poster 54, Paper 1: Demographic and Fishing Gear Monitoring Studies in Coastal Communities of Ondo State, Nigeria

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The knowledge of the socio-economic status of fisher-folks and operational fishing gears are critical in monitoring and observational studies. The major objective of the study was to update knowledge on the socio-economic indices, fishing gears and prime catches of the fisher folks in the coastal communities of Ondo State, south west of Nigeria.

Data were obtained through structured questionnaire and in-depth guided interviews, and were subjected to descriptive statistical analysis. Photographs of the gears in use were taken by digital camera (Aqua sprite water camera model DC 1131 8Mega pixel) and both the gears and their catches were subsequently identified and classified.

The data obtained revealed that fishing was mostly the profession of the young persons and that the educational level of fisher folks was high in the area. Findings also showed that 66% of the fisher folks in the area were professionals while 34% were classified as hobby group fishers, and that the average annual household income of fisher folk households was higher than the income of most government/public employees holding equivalent qualifications in the neighboring area. The gears used by the fisher folks across the study locations consisted mostly of cast net (66%), gill net (14%), hooks and line (08%), fyke net (06%), conical/cone traps (04%) and seine net (02%). The gear-catch compositions were cast net (tilapias and bonga), hook and line (*Sardinella eba*), gill net (*Clarias gariepinus*, *Heterotis niloticus, Polydactylus quadrifilis* and *Psuedotolithus typus*) and seine net (flat fish and tilapia species).

The knowledge obtained in the study will be useful in the enforcement of the appropriate fishing gears, laws/regulations and catch compositions in the studied area.

Keywords: artisanal, artisanal fisheries, fishing gear, fisher folks,

Poster 61, Paper 101: Monitoring artisanal tuna fisheries in the Western and Central Pacific

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The artisanal fisheries across the Western and Central Pacific pose all the challenges experienced elsewhere around the globe - they include developing countries, the participants are diverse and spatially highly dispersed and fishers can be resistant to new monitoring programmes. The size of the vessels, the lack of legislation and the idiosyncrasies of the artisanal fishery including; the use of mixed gear types, diverse landing hours, and scattered points of sale along with personal consumption are some of the challenges that any monitoring programme needs to overcome.

In this presentation we will explore how SPC has established the objectives, design and operational logistics of this comprehensive regionally standard artisanal tuna fisheries monitoring programme. The approach, set up and benefits of the programme, which was originally established to assess the impact of the industrial fishery on small-scale vessels, are discussed. Replacing fisher-lead data collection with monitoring at the point of landing has proved successful. We show how the programme which is now implemented in eight countries is continuing to expand by aligning with other monitoring initiatives, government agencies and NGOs. The collection of good quality data over the initial years has put the programme in a strong position to revise its coverage levels and monitoring priorities. The approach to training is explored with the goal of using observer training developed competencies, allowing recognition and movement of staff between monitoring areas. In gathering good data staffs' communication skills, their ability to keep data confidential and avoid information leakage into small communities, while tackling mis-reporting and over-coming any gender or youth bias of fishers are shown to be essential skills.

The recently developed electronic reporting application "Tails" has brought new demand and interest in the monitoring programme. The benefits of this new technology, including having real-time data and reducing lengthy paper copy transfers from remote places is explored. Also, the challenges of ensuring that the monitoring programme's standards, objectives and design are maintained during this period of transfer to electronic reporting are explained.

Poster 60, Paper 88: Observations in the California Halibut (Paralichthys californicus) Trawl Fishery

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California halibut have been fished in California for thousands of years and continue to be one of the most iconic fisheries in the region today. Historically, California halibut have been targeted by bottom trawl, gillnet, hook and line or by spearfishing. Concerns over the exploitation of the fishery were expressed as early as 1915, and since then, an evolving array of regulations and closures have been implemented to ensure the health of the population (Jow 1990). California state landings records are variable and show large fluctuations in fish caught since 1981. The California Department of Fish and Wildlife conducted a stock assessment in 2011 to address concerns about the status of the California halibut population and concluded that the stock north of point conception was well above its maximum sustainable yield, while the southern stock was depleted to 14% its unfished biomass (Tanaka 2011). Despite the poor evaluation of the southern population, the report determined that the stock is being fished at a sustainable level throughout the state. It was determined that fluctuations in landings are related to oceanographic changes and the low numbers in southern California may result from a succession of bad recruitment years (Tanaka 2011).

Although California halibut is a state managed fishery; federally contracted West Coast Groundfish Observers are deployed on vessels in the trawl sector to collect the data essential to the proper management of the stock. Observers collect discard and biological data specific to the California halibut fishery, as well as recording interactions and collecting biological specimens of marine mammals and seabirds. In the northern California region of the fishery, observers participate in a Green sturgeon tagging and identification project; aimed at addressing the impact halibut trawlers have on threatened green sturgeon. As management looks forward in preserving this fishery, continued observations on population status and the effects the fishery has on other species can increase the chances California halibut will remain a principal fishery in the state.

Poster 59, Paper 82: The Tale of Two Trips: Unobserved vs. Observed Trips in the California Nearshore Fishery

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Jon MCVEIGH[1]

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There has been much discussion and some research investigating the potential "observer effect" in many fisheries around the world. In the nearshore rockfish fishery off the west coast of the US, some hypothesize that fishers may change their behavior and fish in different areas or with different gear when they are selected for observer coverage. We can likely get a better understanding on the extent of this potential bias by comparing the size and species composition of landings from fish ticket data for observed vs unobserved trips. Bias should be evident if vessels are choosing to fish in different areas or with gear that has a higher risk of catching species of concern when observers are not onboard. If bias is apparent, measures can be put into place to reduce it. One such measure is selecting every trip for an extended period of time. This method can help to reduce observer bias by making it financially impractical to fish differently with an observer onboard. By looking at the landing data we can assess the extent of the bias and determine if changes to our sampling plan need to be implemented to address it.

Poster 57, Paper 74: California Artisanal Fisheries: A Case Study in Monitoring Small Vessels in the Live Delivery Nearshore Fisheries

Michael LINDLEY[1]

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A significant portion of ex-vessel seafood value in California comes from small boats participating in the California Nearshore Fisheries, usually delivering their product to market alive. These Nearshore vessels are typically smaller and use hand-operated or lightly mechanized gear, and require fewer capital resources to participate in than other fisheries that have recently been the focus of on-board monitoring. While large-scale deep water fisheries have come to accommodate and even expect monitoring, those participating in the California Nearshore fisheries have largely operated with little or no expectation of Federal observer coverage, both because their small vessels are naturally difficult to work on and also because the fishery is state regulated..

Historically, there were jurisdictional barriers that prevented federally sanctioned observers from collecting data on the vessels operating inside state governed waters. Because most of these fisheries target federally managed species, especially rockfish (*Sebastes spp*.), it took novel cooperation between Federal and State managers to allow the West Coast Groundfish Observer Program (WCGOP) to cover the Nearshore Fisheries. Equally novel was the personal outreach from observers to establish relationships with individual fishermen to get compliance with coverage mandates.

The logistical challenges of actually boarding and working safely on these smaller Nearshore vessels where you could not carry large or heavy scales onboard required innovative equipment and techniques to collect data. The Nearshore fleet only has to meet minimal safety standards due to their size, so the WCGOP also had to re-think observer safety training and how it equips observers for small boat work.

This poster will be a case study of how the WCGOP approached these challenges of jurisdictional and logistical barriers, while addressing the ever-present challenge of getting more coverage in hard-to-access artisanal fisheries.

Poster 55, Paper 48: WatchingMan Pro™: An innovative system to monitor artisanal fishing effort inside protected areas

Fidel FRAGA[1]

FAUSTINO MANSO[1] and Greg HAMMANN[1]

[1] Marine Instruments

There is a growing need to control fishing activities in order to help sustainable fisheries and marine protected areas. Governments, aware of these needs, are seeking for solutions to help these areas and their natural resources.

After a tender process carried out on late Q3 2015 by the regional government of Galicia, Marine Instruments was awarded a pilot project to be carried out in a marine protected area (MPA) called Os Miñarzos. As part of the project, Marine Instruments developed and installed Watching Man Pro™ (WMP) in 87 vessels. WMP is a compact and rugged-IP68 certified equipment integrating GPS receiver, GSM communications and GeoFence technology. This allows to monitor the vessel´s position; the system works with colour coded geofence signal lights on the vessel (green= out of MPA, blue= inside MPA and red= exit MPA). The equipment also has the possibility of interfacing sensors to support crew´s safety such as man over board and monitoring the vessel status. The location of each vessel and the route and the time spent on each area can be visualized by the authorities at real time from any computer on a web interphase. The information is also available via an app on any smartphone.

The project will run for 2 years after which a decision to implement it for the entire fleet will be evaluated. As a potential phase II of this project, Marine Instruments will offer a remote electronic monitoring system called eEye™. This system is based on still images providing a stand-alone and cost-effective solution for fully documented fisheries specially developed for small and medium size vessels.

Poster 62, Paper 113: An Observer program's contribution to fisheries zoning and management in the Exclusive Economic Zone of Costa Rica for tuna and tuna-like species.

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An Observer program's contribution to fisheries zoning and management in the Exclusive Economic Zone of Costa Rica for tuna and tuna-like species.

In Costa Rica in 2014 a new regulation was signed (Decreto Ejecutivo 38681 MAG-MINAE) for zoning and management of tuna and tuna like species fisheries in the Exclusive Economic Zone (EEZ). Four polygons are established with regulations for national artisanal longline fleets and foreign industrial purse seines fleet.

The aim of this work is to present the EEZ areas utilization by national artisanal longline fleets and their relation with the new polygons. Data were collected in observer program on board 83 boats, from May 2005 to June 2012, in 1693 sets. Fisheries were directed to mahi mahi (1135), sharks (285), tuna and billfishes (273). Capture by unit effort (CPUE) data are presented by fishery and by polygon, for both target and non-target species. These data were obtained in collaboration with longline fishing sector Recommendations are made for fishery management in the polygons of the EEZ and also the importance of development of observer program in Costa Rica is shown, where there are recent incipient efforts to deploy observers in these fisheries and develop an official observer program.

Poster 56, Paper 73: Newport Beach Dory Fleet: The History of an Artisanal Fishery

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Artisanal fisheries fill a niche in the commercial fishing world that is often overlooked. Historically people have sought out fresh, affordable, locally sourced seafood and the same holds true today. Consumer's attitudes as well as fishing regulations are constantly changing and artisanal fisheries have to adapt accordingly in order to remain successful. A recent shift in consumer's tastes has placed much more value on how, where, and by whom their food is caught. Artisanal fisheries find themselves at the forefront of this movement and are quickly becoming an increasingly appealing alternative to more common large -scale fisheries.

The Newport Beach Dory Fleet has been in existence since 1891 and began as a marketplace where fishermen could sell their catch directly to the public. It is an asset to the community economically, but also culturally and historically, being one of the oldest operating fishing fleets and markets in California as well as being recognized as a historical landmark. The traditional sharp bow, flat bottomed dory boats have slowly been replaced by more efficient modern boats but the small size of the fleet and the longstanding relationships formed between fishers and their customers maintains the appeal of the small, low impact fishery.

I intend to create a poster about the History of the Newport Beach Dory Fleet as an artisanal fishery and to showcase the hardships as well as the successes the fleet has faced in its existence. I will also show how the fleet has adapted to remain prosperous amid new fishing regulations as well as changes in consumer tastes. The West Coast Groundfish Observer Program (WCGOP) covers several vessels in the fleet and I will discuss how observer coverage, sampling, safety and training can differ when covering an artisanal fishery such as the dory fleet. Recommendations will also be made regarding what other artisanal fisheries can learn from the dory fleet, as well as what observer and other monitoring programs can learn from how the WCGOP observes this fleet.

Poster 58, Paper 78: Sheephead : Modern Day Observing in Artisanal Fisheries

Steven TODD[1]

[1] **WCGOP**

Artisanal fisheries in the San Diego, CA region pre-date discovery of the new world by millennia. From the ancient Kumeyaay civilization to our modern day society, these fisheries continue to provide jobs and food for the local inhabitants of the area. Although our fishing fleet has evolved beyond artisanal status to be defined by more modern standards that include power driven vessels, hydraulics, and high tech electronics, some gear types have remained artisanal. The use of gill nets, hook and line, and fish pots are fishing techniques that have secured a place of importance in the archeological and historical timeline of fishing in the area, and they are still currently used. Fish pots continue to be the primary gear used to catch and deliver one of our dominant reef species to market, the California Sheephead (*Semicossyphus pulcher*).

Federal and California state guidelines dictate the management measures for this species. Participants in this fishery must possess a limited entry permit and must comply with quotas, closed seasons, closed areas, required safety gear as defined by the U.S. Coast Guard, and allow observer coverage for trips during a two-month trip period, selected by random means, during each calendar year.

Fish tickets, shore-side port sampling, and robust data collection, at sea, by observers in the West Coast Groundfish Observer Program (WCGOP) help to monitor and manage healthy stocks. While the target observer coverage rate is 20 percent in this fishery, actual coverage rates are less, with the difference attributed to waived trips for weather, observer safety, vessel size and condition, crew size, observer availability, and/or fleet avoidance.

As in any fishery, longevity of the management program and local observers serving the area foster open channels of communication with the fleet and further aid in their participation. Niche fisheries such as this one represent a puzzle of local activities that can only be assembled and better understood slowly and methodically.

POSTERS

How Much Observer Coverage And Monitoring Is Enough? Methods For Reducing And/or Incorporating Biased Data Collection.

Poster 63, Paper 122: See what

Michelle CAMARA[1]

[1] none

Overall the Alaska observer program does a good job at the ecosystem approach for their data. Observers are required to collect data on many aspects of the ecosystem. This includes data collected on mammals, birds, fish and invertebrates, which is collected by many observers over all Alaskan waters.

Like all good things there is room for improvement. Over the 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 and birds. Many observers are so concentrated on their fish data that they do not want to see other organisms. I have heard many times that they did not look for short-tailed albatrosses because they did not want to write it up. Captains ask me do you want me to tell you if I see a whale? And 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. I have also seen a decline of the identification of small invertebrates. They have them in the manual but I don't see anyone pushing for better identification of these organisms. Some observers I talk to tell me they just put down invert unidentified because they are not that important. I have been doing this for ten years and I still find things I can't identify. For me it is a challenge and I look forward to those moments. 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.

Poster 64, Paper 148: Implementation, evaluation, and future of the automated observer deployment system used by the Northeast Fisheries Observer Program

Sarah CIERPICH[1]

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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.

POSTERS

How Can Fisheries Monitoring Programs Support An Ecosystem Based Approach To Fisheries Management?

Poster 67, Paper 153: How can fisheries monitoring programs support an ecosystem based approach to fisheries management?

Samuel BEAR[1]

[1] IAP/NOAA

It is unquestionable that commercial fishing operations have an impact on the ecosystem. The degree of said impact depends 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 on which trophic level the target and by-catch species occupy. Fisheries that target top level predators, such as tunas, billfish, sharks, etc. would have significantly different impacts than 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 the 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. These observations could help determine if/how the natural foraging behavior are affected and what possible effects it would have on the ecosystem.

Observer data could also be utilized to determine seasonal abundances of various bycatch species in specific locations and help determine migratory or spawning movements and in turn help implement regulations that could reduce incidental takes of species that are vulnerable. Observers could also focus on identifying the 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.

Impacts on habitat could also be monitored, such as damage/destruction to sponges, corals, grass beds, sargassum, and other substrates that many species utilize for spawning sites and shelter.

Poster 68, Paper 169: Using observer data to support an ecosystem based approach in CCAMLR fisheries

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The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) was founded under the 1982 Convention of the same name, and is unique in that it is based on an ecosystem and precautionary approach to the conservation of marine living resources in the CCAMLR Area. The development of this ecosystem-based management approach requires the collection of accurate and verifiable fisheries statistics, as well as biological data. To facilitate this, the CCAMLR Scheme of International Scientific Observation was established in 1992 and gathers fisheries-related data required for assessing the target species stock status, as well as data that assesses the impact(s) that fisheries may exert on other components of the ecosystem, particularly on non-target species of fish, seabirds, marine mammals and vulnerable marine ecosystem taxa. The data are also used to review the effectiveness of, and compliance with, conservation measures that are designed to mitigate those undesirable impacts of fishing.

Poster 65, Paper 145: FISH EGGS AT NIGHT IN THE COLOMBIAN PACIFIC OCEAN: FIRST APPROACH

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Evaluations of ichthyoplankton (fish eggs and larvae) are important in ecological studies and fisheries prospections, since help to define periods and breeding areas, and because such early stages are a key link within the trophic web of zooplankton and upper levels. For assessing the distribution and abundance of fish eggs in September 2007 along the Colombian Pacific Ocean (CPO), zooplankton was collected by oblique tows to 184 m mean depth with a 60-cm bongo sampler (294- and 520-µm mesh). The abundances reached 53382/100m^3 in the first net and 631/100 m^3 in the second one.

The largest aggregations in the neritic south area of the CPO can be associated with spawning of fish stocks, high productivity, and the proximity of mangrove swamps, which are spawning and nursery grounds. The highest abundances in ocean waters could be partially explained by transport and retention processes, as an effect of the complex system of currents in the CPO. Considering both nets, diel variation was not wide (day 2476/100 m^3 *vs.* night 2200/100 m^3), suggesting continuous spawning, although many fish have higher spawning at night to avoid predators. Surface water *temperature and salinity* did not appear to play a significant role on distribution and abundance of eggs. This scenario can change, depending on the sampling month, fish species and the reproductive mode and location and extent of spawning grounds, and because fish *spawning* behavior is dictated by photoperiod (length of daylight).

Poster 66, Paper 8: Modeling Community Structure and Species Co-occurrence Using Fishery Observer Data

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In this study we modeled fishery observer data to compare methods of identifying community structure using cluster analyses to determine stratifications and probabilistic models for examining species co-occurrence in the Gulf of Mexico deepwater reef fish fishery. Comparing cluster analysis methods, the correlation measure of dissimilarity in combination with average agglomerative linkage was the most efficient method for determining species relationships using simulated random species as a comparison tool. Cluster analysis revealed distinct species stratifications and in combination with multiscale bootstrapping generated probabilities indicating the strength of stratifications in the fishery. A more parsimonious approach with probabilistic models was also developed to quantify pairwise species co-occurrence as random, positive, or negative based on the observed versus expected fishing sets with co-occurrence. For the most common species captured, the probabilistic models predicted positive or negative co-occurrence between 84.2% of the pairwise combinations examined. These methods could provide fishery managers tools for determining multi-species quota allocations and offer insights into other bycatch species of interest.