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WWF

WORKSHOP

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Smart Fishing Initiative

WWF MONITORING, CONTROL, AND SURVEILLANCE (MCS) EMERGING TECHNOLOGIES WORKSHOP

"Seeking MCS Solutions for the Big Ocean Sovereignty States of the Western & Central Pacific Ocean"

The goal of this workshop was to help Pacific Islands Forum Fisheries Agency (FFA) member states better understand the existing MCS environment and objectively review and assess the available emerging technologies that might help contribute to less expensive, more effective, and more efficient MCS at a national and regional level.

Workshop Summary Report

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Foreword

As early as 1609, one of the world's prominent authorities on freedom of the seas and fisheries, Dutch jurist Hugo Grotius, professed the inexhaustibility of the seas, that the ocean was so vast and the life so prolific within it that no human effort would ever be able to diminish the amount of fish found within it. Almost 280 years later, renowned British biologist Thomas Huxley again asserted that overfishing or "permanent exhaustion" was scientifically impossible, and stated that probably "all the great sea fisheries are inexhaustible". Fifty years before Thomas Huxley made this statement, a British economist, William Forster Lloyd, first described the social and psychological tendency of a population to overexploit a resource to support their own self-interest in disregard of the collective interests of the population and the resource. This concept was further fleshed out by Garrett Hardin, an American ecologist, who termed this tendency the "Tragedy of the Commons" in a paper published in the journal *Science* in 1968. Of course, today we know Grotius and Huxley to be wrong and Lloyd and Hardin to be right through a repetitive series of unfortunate examples throughout history. However, the criticism against Grotius and Huxley is not entirely deserved as they never anticipated the huge advancements in technology that would come into common practice.

In the early days of commercial fishing, effort and catch was naturally restricted by limitations in technology. Sailing vessels were limited by wind and weather. Fishing gear such as lines, nets, and hooks were difficult and time intensive to produce and maintain from naturally available materials. Until the early 1900's these natural technological limitations kept fishing effort and exploitation levels in check, ensuring relatively healthy fish populations despite some minor localised depletion in some regions. With the advent of the steam engine and, later, the internal combustion engine, fishing vessels were able to achieve much greater ranges and target fish stocks more efficiently and effectively in places they never had before. Later, with the invention and further engineering of the power block hauler as well as stronger, lighter, and cheaper petroleum-based synthetic line and net materials, fishing power began to reach further unprecedented levels. Today, fishing vessels use high efficiency diesel engines, sophisticated and specifically engineered unprecedented refrigeration capacity including Ultra Low Temperature freezers that can instantaneously freeze and store product at less than -20C, and an electronics array reminiscent of Gene Roddenberry's Starship Enterprise to find and track schools of tuna. In the short timespan of approximately 60 years, fishing has evolved from small single sailing vessels using tools relatively unchanged since the bronze age to massive fleets of huge steel-hulled vessels capable of catching and storing hundreds of metric tons of fish in a single set.

In spite of these advancements, fisheries managers have struggled to keep up with the rapidly evolving fishing technologies and increasing effort in the tuna fishing fleets, often relying on the same tools that have traditionally been used since the beginning of modern fisheries management efforts including paper-based reporting and at-sea boarding and inspection. The technology and effort employed in the modern tuna fleet has largely outpaced the ability and capacity of fisheries management and enforcement personnel to apply, monitor, and enforce regulatory requirements in the fishery. However, with new advances in satellite, computer, and robotics technologies, it has become possible to manage fisheries more effectively and efficiently. Satellite and drone surveillance, real-time electronic reporting, and on board electronic monitoring of fishing activity using cameras stand to revolutionise the ability of fisheries managers to sustainably manage fish stocks in the public interest.

The tuna fisheries in the Western and Central Pacific Ocean (WCPO) region support a fishing industry conservatively worth between USD$4-6 billion a year, in addition to being socially and culturally important to the Pacific Islands. Fisheries capacity and effort continues to expand in the region to a level that most already believe is unsustainable. Existing monitoring, control, and surveillance measures are unable to keep up with this expansion in capacity and effort. Therefore, the future of fisheries management could lie in the ability of the regional fisheries managers to harness the power of these new technologies for the benefit of the resource and these people who depend on the resource for their livelihoods and sustenance. The technologies presented at the WWF MCS Emerging Technologies Workshop hold promise to address some of the MCS challenges in the region.

Alfred Lee "Bubba" Cook Jr.
WWF Western and Central Pacific Tuna Programme Manager

Introduction

The genesis of the WWF Monitoring Control and Surveillance (MCS) Emerging Technologies Workshop began amidst informal discussions with several of the Big Ocean Sovereignty State (BOSS) representatives at the September 2013 Technical and Compliance Committee (TCC) meeting of the Western and Central Pacific Fisheries Commission (WCPFC) about monitoring and compliance challenges in the region. All of these representatives of these small Pacific Island nations acknowledged the inherent difficulty of managing large, industrial tuna fisheries over a vast expanse of ocean measuring millions of square kilometres. As the resource owners, they sought ways to ensure that not only the stocks be managed sustainably for the long-term benefit of their nations, but also that the revenues from the region's fisheries are fully captured and maintained by their nations. Many expressed concerns with illegal, unreported, and unregulated (IUU) fishing activities in the region that continue to undermine the BOSS states efforts to ensure proper management of their fisheries. Thus, they expressed a desire to explore new technologies that might address some of the MCS challenges in a more economical, effective, and efficient way.

Consequently, WWF sought to conduct a workshop to review a variety of different technologies available to assist BOSS fisheries managers in achieving their MCS goals. In identifying an appropriate audience, WWF determined that the regional subset of the Pacific Islands Forum Fisheries Agency (FFA) represented a good candidate. The FFA is an intergovernmental organization based in the Pacific Islands region and comprised of 17 member states and is responsible for strengthening national capacity and regional solidarity to ensure the sustainable management of the region's highly valuable tuna fisheries. WWF further determined that the FFA represented the appropriate entity for presenting these technologies because the FFA provides the regional management infrastructure for collective MCS efforts in the WCPO among its members. In identifying the venue and timing, with the advice and support of the FFA, WWF concluded that conducting the workshop at the FFA Regional Conference Centre preceding the FFA MCS Working Group Meeting and subsequent WCPFC Electronic Reporting and Electronic Monitoring Workshop would not only ensure appropriate participation from the target audience, but would also serve to contribute to and complement the FFA and WCPFC events that followed. WWF also sought to capitalise on the momentum created by the International Monitoring, Control and Surveillance Network (IMCS) Fourth Global Fisheries Enforcement Training Workshop held February 17-21, 2014, in San Jose, Costa Rica.

WWF chose to define "emerging" technologies to also include technologies that are well-established, such as satellite and electronic monitoring technologies, but that have evolved or advanced significantly in recent years. More recently however, technologies, such as Unmanned Aerial Vehicles (UAVs) and Autonomous Surface Vehicles (ASVs), represent truly emerging technologies that have only entered civilian use within the last 5-10 years. Over a 5 month period, WWF conducted extensive research regarding these emerging and evolving technologies, reaching out to over 40 service and technology providers that specialised in various potential MCS applications. In determining the content of the MCS Emerging Technologies Workshop, WWF used this research to determine the most applicable technologies for use in fisheries MCS, including:

- Autonomous Surface Vehicles (ASVs; aquatic robots)
- Ocean Sensor Technology
- Full Catch Documentation Based E-logbook and E-reporting
- Electronic Monitoring (Onboard Video and Sensors)
- Unmanned Aerial Vehicles (UAVs; "drones")
- Integrated Satellite Technology
- Advanced Cloud-Based Data Storage and Processing (Big Data)

WWF secured the commitment of seven technology providers representing six of the identified technologies. Over a 4 week period, WWF delivered a series of brief reports and web links to technology providers to help them understand the current state of fisheries management and MCS in the WCPO.

WWF specifically sought to design the workshop to be more than just a "show and tell" for the technology and service providers. Thus, WWF carefully crafted the agenda in a way to get the participants to first think very carefully about their current MCS infrastructure: how it operates; where the gaps might be; where the expenses are; how they might economise the system. Then, WWF sought to review the objectives of the FFA Regional MCS Strategy and draw some workshop specific objectives from that discussion. Finally, after considering carefully the MCS baseline and workshop objectives, participants were encouraged to look at the available emerging technologies and how they might (or might not) help achieve those objectives in an efficient and effective way. The overarching goal of the Workshop was to seek

out and understand the challenges and identify potential solutions, while avoiding the view of the technologies as a solution in search of a problem.

Consequently, WWF designed an agenda that, on Day 1, reviewed important considerations and features of the current MCS infrastructure. While it was largely a review for the FFA member state representatives, WWF determined that it was critical that the technology and service providers were in the room for this discussion so that they could understand the nuances of the region's MCS infrastructure and how their particular technology or service might play a role. WWF intended Day 1 to set a clear baseline from which to consider the technologies from all perspectives involved. Then, after reviewing the MCS infrastructure on Day 1, on Day 2 the technology providers were given the opportunity to explain how their technologies might help the MCS experts in the room meet the objectives they had discussed the previous day. In the end, the goal was to improve the understanding of how the technologies, both in their current state and how they are expected to evolve, might fit into the broader current MCS infrastructure and fisheries management regime and those in the future.

The Workshop

The WWF Monitoring, Control, and Surveillance (MCS) Emerging Technologies Workshop, was held at the Forum Fisheries Agency (FFA) Regional Conference Centre on March 21-22, 2014, in Honiara, Solomon Islands. WWF conducted the workshop with the generous advice and support of the FFA. WWF designed the workshop to assist the member states of the FFA in better understanding the relationship of the new and developing available technologies to the existing MCS infrastructure and how those technologies might play a role in its future development. Specifically, the workshop focused on achieving the following outcomes:

- Clarification and improved understanding of National and Regional MCS objectives;
- Enhanced comprehension of existing and emerging MCS tools within the context of a broader view of the existing MCS infrastructure;
- Better understanding of how current and emerging MCS tools and approaches might integrate to achieve a more efficient and effective comprehensive MCS infrastructure; and
- Improved understanding of the potential applications and costs of a few prominent emerging technologies within the context of the existing MCS infrastructure.

WWF designed the workshop as a two phase event conducted over two days. Phase 1 consisted of presentations conducted by FFA regional experts including a basic Review of Current State of MCS Techniques and Technology; Current Technology Capabilities and Limitations; and a Summary of the State of MCS in the Region. Phase 1 was largely review for the FFA member participants, but was designed to provide crucial insight for the technology providers to fully understand the opportunities and challenges for the various technologies in the region. By fully understanding the current status of MCS in the region, technology providers can better adapt their technologies to meet the needs and desires of fisheries managers in the region. Phase 2 consisted of presentations conducted by the technology providers to demonstrate the potential for each technology in an MCS context. Phase 2 allowed FFA participants to better understand the technology and consider its potential application in their respective regions. During the last session of Phase 2, FFA participants and technology providers collectively discussed implementation challenges for the various technologies.

The workshop consisted of 6 primary elements covered over 2 days:

- Overview and review of the current state of MCS techniques and technologies used in the WCPO region;
- Identification and clarification of workshop objectives;
- Identification of current technology capabilities and limitations;
- Panel review of strengths, weaknesses, opportunities, and threats in the current MCS Matrix;
- Presentations by the technology and service providers; and
- Panel review of implementation requirements and challenges for the various technologies.

Through the presentations of regional and national MCS experts on key MCS issues on Day 1 and the presentations of the new technology providers on Day 2, participants were able to come together to help identify the right technologies for the right conditions for each FFA member state in the Western and Central Pacific Region. At the conclusion of the

workshop, WWF requested that all participants reflect on the workshop presentations and outcomes and submit answers to an online survey.

The final Agenda of the workshop is included in Appendix A. The list of presenters and their presentation topics are included in Appendix B. Copies of all workshop presentations, additional information shared by participants and photos from the event may be accessed from the following web link:
https://drive.google.com/folderview?id=0B79T78ZKDRNiV1Y1NkJjRF83blk&usp=sharing

A copy of all compiled survey responses may be found in Appendix C.

Goals, Objectives, and Outcomes

Through a focused session and written submissions, on Day 1 meeting participants identified and confirmed the following goals, objectives, and outcomes for the workshop. Specifically, participants confirmed the following two goals for the workshop:

1. Improve and clarify FFA Members' understanding of the existing MCS environment.
2. Objectively review emerging and advancing technologies that might contribute to less expensive and more efficient MCS at a national and regional level.

Discrete objectives for each of those goals were further defined by participants along with desired outcomes of achieving those objectives.

Goal 1 Objectives

Objective 1: Clarification and improved understanding of existing national and regional MCS objectives.

Desired Outcomes

- Improved understanding of individual national MCS goals.
- Understanding of whether a mechanism or structure exists to allow sharing of UAS resources.
- More work conducted at a national level
- Review of Standard Operating Procedures (SOPs)
- Further development of National Plans of Action (NPOA) to address IUU fishing.
- Summary of national and regional MCS objectives.
- Members review objectives to ensure they are still relevant and meet national requirements.

Objective 2: Enhanced comprehension of existing MCS tools within the context of a broader view of the existing MCS infrastructure.

Desired Outcomes

- Members review the current MCS infrastructure now available for the existing MCS tools and determine if or where there are gaps or challenges that can be reduced or eliminated.
- Understand how much "intelligence" or "undercover" work is undertaken that could present an opportunity for new technology.
- Understand whether a centralised database for VMS, AIS, Observers, and other tools may be possible.
- Improved understanding of how existing MCS tools vary among different nations.

Objective 3: Better understanding of current gaps in the existing MCS infrastructure.

Desired Outcomes

- Improved understanding of how novel technologies such as genomic or genetic tags may assist traceability and, in turn, MCS in the tuna fisheries.
- Identify where the gaps are and how best the gap can be filled.

Goal 2 Objectives

Objective 1: Improved understanding of emerging and advancing MCS tools and approaches available for incorporation into the existing MCS infrastructure.

Desired Outcomes

- Members are well briefed on the available MCS tools and any cost implications directly to members if implemented.
- Members are kept in the loop and updated on available information from any trials/studies carried out on any new MCS tools.
- A summary of what is required to improve emerging MCS tools to improve their utility in MCS.
- Engage data sharing agreements among members to facilitate a better understanding of MCS tools.
- Improve understanding of new generation systems capable of detecting possible targets for investigation as "cueing" tools.
- Understand which countries are the technology leaders.

Objective 2: Better understanding of if or how emerging MCS tools and approaches might integrate into the current MCS infrastructure to achieve a more efficient and effective comprehensive MCS system.

Desired Outcomes

- Members become fully aware of the implications of the emerging MCS tools to their national programmes.
- National and regional entities integrate training with regional training institutions or universities to incorporate MCS training within their coursework.
- Detailed understanding of regional and national databases and their accessibility to alert or cue for other MCS actions.

Objective 3: Improved understanding of the costs of a few prominent emerging technologies within the context of the existing MCS infrastructure.

Desired Outcomes

- Enhanced understanding of what the desired and minimum capability is required in relation to cost.
- Improved understanding of funding options such as national budgets, government aid, NGOs, fines, cost recovery, and other options.
- A clear assessment of efficiency of individual legal systems.
- Integration of information from national and sub-regional components into a single platform for data management in order to reduce costs.
- Better understanding of funding options that include a "user pays" policy.
- A cost/benefit analysis, plus risk management and likely outcomes of various options.
- Members achieve a greater awareness of the costs associated with new technologies and how these costs can be accommodated by implementing agencies at a regional level without passing costs on to members.

Objective 4: Determine any legal or policy impediments to implementing some of these new technologies.

Desired Outcomes

- Identify impediments and seek assistance from expert agencies to make implementation of new technologies possible.
- Identify key regulations and restrictions on the use of UAVs and ASVs.
- Review of current MTC and review of National Fisheries Management Plans.

- Review of regulations and national laws.
- Improved understanding of efficiency of individual legal systems.

Summary

After outlining the objectives and desired outcomes identified by the meeting participants, WWF encouraged the participants to take the following into consideration as the meeting proceeded:

- Keep the Regional MCS Strategy (RMCSS) and MCS Workshop goals and objectives in mind.
- Consider the improvement of the regional and national MCS system on a holistic basis.
- Think about the emerging and advancing technologies critically and objectively with respect to the current MCS infrastructure.
- Consider the MCS tools currently available and in use as well as the capacity, capability, and the legal framework nationally and regionally to support the existing MCS infrastructure, and then contemplate the potential for emerging technologies.

The anticipated or desired outcomes represented a very ambitious vision for the Workshop. While not all of the outcomes were achieved specifically, several were successfully achieved to varying extents.

Day 1: The State of MCS in the WCPO

While this section will not resubmit all presentations in detail, it is intended to encapsulate or distil some of the major points and themes as well as provide a summary of the discussion that followed. All presentations are located at: https://drive.google.com/folderview?id=0B79T78ZKDRNiV1Y1NkJjRF83bIk&usp=sharing

Introduction and Opening Address

Alfred "Bubba" Cook provided a brief introduction to the workshop including a film short he had developed that emphasised the dramatic changes in technology over the last century. Through this film, he pointed to the astounding advances in fishing technology that has vastly increased fishing effort and intensity, noting the difficulty of fisheries management to keep up with these advances. The film highlighted evolution from the tuna industry's modest beginnings to the highly sophisticated and technologically dependent industry that it is today. The film then used references to popular culture and science fiction to emphasise how far technology has evolved. Mr Cook challenged participants to carefully consider the opportunity presented by the Workshop, prodding them to think about the short film on technology advancements and consider:

- Where have we come from?
- Where are we now?
- Where would we like to be?
- Where can we be? What is possible?
- What do we want to achieve through this workshop?

Review of Current State of MCS Techniques and Technology

Overview of Current MCS Infrastructure

Mr. Noan Pakop, FFA Director of Fisheries Operations, provided a presentation on the Overview of Current MCS Infrastructure, with a discrete focus on National MCS Measures, Regional MCS Measures, and the FFA Harmonised Minimum Terms and Conditions (HMTC) Regional Framework.

Discussion that followed the presentation primarily focused on questions regarding the ability to impose appropriate measures that effectively address IUU when those measures are not legally binding. Another question raised was whether or at what level regional IUU efforts could impact IUU, which tends to be a global issue. Mr. Pakop emphasised the need for National governments to make regional measures such as HMTCs binding through National legislation. Referencing to the high cost burden of MCS on some states, one participant asked whether authorities had considered cost recovery mechanisms to recoup some of the costs of managing the industry from the industry. Mr.

Pakop noted that the regional legal environment is complex and the fishing industry is diffuse and widespread, creating challenges for designing effective and easily administrated cost recovery programmes.

Understanding Basic Gaps in MCS Framework

Mr. Apolosi Turaganivalu, FFA Compliance Policy Officer, provided a presentation on Understanding Basic Gaps in MCS Framework, with a specific focus on the Regional MCS Strategy. Mr. Turaganivalu specifically noted the following broad categories as significant gaps in the overall MCS infrastructure that are in need of improvement:

- Data management and MCS coordination;
- Legislation and management plans;
- Port control and inspection; and
- Observer schemes.

With respect to Data Management and MCS Coordination, Mr. Turaganivalu pointed out that without valid and timely information, managers simply cannot effectively manage fisheries and that this requires improved coordination and data sharing. Regarding legislation and management plans, he recommended implementing the principles and measures agreed at the WCPFC at the national level and attempting to link management plans with legislation. Considering port control and inspection, he noted the need for stronger measures and better transparency. Lastly, with respect to Observer Programmes, he pointed out the inefficiencies in how the data is collected and used as well as the costs and level of coverage in the fisheries as significant gaps. Overall, Mr. Turaganivalu identified the high financial costs of implementing and managing some of these programmes as one of the major obstacles to their full and appropriate implementation.

Discussion focussed primarily on the need for cooperation between parties in the region and that there are things that can be done collectively in the region by the FFA member states to improve the situation. It was also noted that there are currently only 5 countries that do not fully share all their information within FFA, but the hope is that the information will be forthcoming soon. Other participants raised questions regarding the coordination efforts for air surveillance and at sea boarding and inspection and how those relate to some of these other needed coordination efforts.

International Cooperation

Mr. Wez Norris, FFA Deputy Director General, provided a broad overview of various aspects of International Cooperation within the region, spanning from the UN Convention on the Law of the Sea (UNCLOS) to the UN Fish Stocks Agreement (UNFSA) and Convention on Highly Migratory Species. While Mr. Norris pointed out that the various agreements created sovereign rights over fisheries and an obligation to manage those fisheries sustainably, he drew attention to some of the problems associated with establishing artificial legal boundaries and the incompatibility of measures from region to region. He noted that flags of convenience and a lack of transparency on the High Seas further frustrate the efficacy of the international agreements.

Mr. Norris remarked that while the High Seas creates substantial MCS challenges, the WCPO is fortunate because the High Seas areas are of relatively less significance than in other regions, only existing as small pockets in the WCPO as opposed to large expanses of ocean in other regions such as the Atlantic or Indian Oceans. However, he expressed urgency that the WCPFC should substantially increase its efforts to address uncontrolled fishing on the High Seas. Lastly, he noted in response to a question regarding the continuing threat to fisheries despite these international agreements that the FFA member states have frequently set the bar that has pushed the rest of the globe to catch up, pointing out that the Niue Agreement sets up a discrete obligation for signatories to enforce other signatories' laws.

Summary

Presenters gave an effective and comprehensive overview of the general status of MCS measures in the region and some of the gaps in the MCS infrastructure. Some of the overall themes from the sessions included:

- A need for harmonisation in the legal and regulatory standards throughout the region;
- Costs for implementing and managing some essential MCS programmes represent one of the major obstacles to their full and appropriate implementation;
- Management of the High Seas represents a major MCS challenge that must be dealt with in the WCPFC; and
- Cost recovery is desired, but frustrated by a complex legal environment and a diffuse and widespread fishery.

Current Technology Capabilities and Limitations

The Paper Trail – Written Documentation as an MCS Tool

Mr. Dennis Yehilomo, FFA MCS Analyst, presented on the use of written documentation as an MCS tool. Highlights of the presentation included the current importance of written documentation to both scientific and MCS efforts. He noted that despite inefficiencies in collecting and processing data it remains essential to fisheries management in the region. Of key significance was the estimated cost of between USD$1M - $5M necessary to fully implement and administer the observer programme. Mr. Yehilomo also noted the substantial time frame and logistics necessary to get data from the point of collection to the scientists and managers for analysis.

Much of the discussion focussed on the time frame necessary to make use of the information collected. One participant calculated in excess of 120 days between collection and point of analysis for most information. Another experienced participant noted that 120 days would be optimistic and also pointed out the need for cost recovery to fully recapture the expense of administering the paper programmes.

Electronic Surveillance (VMS, eCDS, AIS, etc.)

CMDR Mike Pounder, FFA Surveillance Operations Officer, provided a presentation on MCS Electronic Surveillance including VMS, AIS, Long Range Identification & Tracking (LRIT). CMDR Pounder explained that while VMS constitutes an indispensable MCS tool in the region, the introduction of AIS to the Regional Surveillance Picture (RSP) in November 2012 proved to be “eye opening” with regard to activity that they could not previously see. He also noted that LRIT could also potentially play a role in helping to understand activities at sea among some vessel classes.

CMDR Pounder noted that of the technologies contributing to the RSP (VMS and AIS), AIS represents the weakest due to the ability to “spoof” signals, which involves manually inputting incorrect information for the express purpose of obscuring the true intent and operation of your vessel. However, despite its fallibility he also noted that new requirements for Unique Vessel Identifiers (UVI) such as International Maritime Organisation (IMO) numbers could help reduce some of the spoofing. He also noted that adoption of AIS is up 30% this year and there are movements globally to make AIS a standard requirement, additionally suggesting that it would be preferable if AIS were mandatory in the WCPO.

The discussion among participants focussed on the perceived fallibility of AIS and growth in the technology globally. One participant noted that despite some inaccuracies, over 98% of vessels accurately report and that other mechanisms could help identify those vessels that are intentionally falsifying information. Several participants noted the need to make AIS a regional requirement for all vessels as a way to further fill out the regional surveillance picture and also provide a redundancy system for VMS.

At-Sea Boarding and Inspection

Mr. Mark Young, International and Domestic Fisheries Compliance and Enforcement Consultant for FFA, provided a presentation on At Sea Boarding and Inspection (ASBI). Mr. Young comprehensively described the authority and process involved in conducting boarding and inspections. One of the primary messages was that the method constitutes the most expensive form of fisheries enforcement with an example of a single day costing approximately USD $720K. However, he also pointed out that social and normative influences such as peer pressure, the perceived legitimacy of laws and regulations and personal moral behaviour impact a fisherman’s decision to conduct illegal fishing and that a combination of these various influences, combined with a perceived overall effectiveness of the enforcement regime to detect and punish potential illegal fishermen, can impact the overall level of compliance with fisheries regulations.

A key point made by Mr. Young was that the Niue Agreement could substantially improve the performance of the ASBI by providing a mechanism for cross vesting enforcement powers, sharing assets, minimum data sharing, and cooperation beyond just fisheries. He also noted the need for enforcement personnel to be able to readily and efficiently access important data preceding or during inspections, including increasingly more complex rules and regulations as well as applicable vessel records, suggesting that e-job aids or tablet computers could play a role.

The discussion among participants focused primarily on the costs and logistics necessary for an effective program. Mr. Young explained that the cost example in the presentation was based upon published standard ratings from USCC, Pacific Patrol Boats and US Navy and included not only administrative costs, but also direct costs that came out of the operations

Manned Aerial Surveillance

CMDR Mike Pounder, FFA Surveillance Operations Officer, provided a presentation on Manned Aerial Surveillance in the WCPO. CMDR Pounder emphasised the desire for "cheap and cheerful" operations using small, inexpensive, and readily available aircraft, but also noted some of the challenges related to technical and logistical constraints of manned surveillance. As a general observation, he suggested that a private aircraft leasing option is more efficient and technically feasible than the military supported option. Additionally, he recommended that "Project Sea Dragon", which incorporates modern technology such as X-band Synthetic Aperture Radar (SAR) and gyro-stabilised cameras with infrared, still, and ultra HD video capability into the "cheap and cheerful" option along with satellite cueing tools, could present a valuable option in the future. In conclusion, CMDR Pounder noted that Manned Aerial Surveillance could only be considered a single part of a multi-layered, multi-lateral surveillance programme.

One participant questioned the ability of human photographers to take useable photos using only a handheld camera. CMDR Pounder responded that while gyro-stabilised cameras are increasingly available, handheld photos are still the most common and along with the skill of a good photographer and tools that can help lock onto targets, excellent day/night video and stills can be captured. Another participant noted the challenges of asset succession with aircraft similar to the Pacific Patrol Boat (PPB) programme. Noting the weather limitations for aircraft and PPB, he asked whether there were any plans to increase technologies such as more automated cameras on those platforms. CMDR Pounder responded that, per Australia Defence Ministers meeting last year, the Pacific Security Maritime Project is planning a PPB replacement project as succession planning rolling out in 2018, which will consider the size and capability of vessels acknowledging that one size does not fit all given that many remote ports cannot take bigger boats due to draft and length overall (LOA).

Port State Measures

Mr. Wez Norris, FFA Deputy Director General, provided a presentation on the use of Port State Measures (PSM) to address MCS challenges. Mr. Norris noted that using the "choke point" method offered by PSM offers a distinct cooperative MCS opportunity in the WCPO region. He remarked that the recognition of ports as a sovereign territory that facilitates setting uniform and collective inspection standards presents a unique opportunity. Compared to other MCS approaches, Mr. Norris noted that, PSM are cheap and efficient while also providing large amounts of MCS data and allowing for greater cost recovery. However, he also noted that the UN Port State Measures Agreement (PSMA) is too broad and requires a more flexible approach that considers the disproportionate burden on the Pacific Islands nations, noting that there are likely good reasons that only 9 states have ratified the UN PSMA globally.

One participant asked how a conflict between licensing conditions and treaties is handled. Mr. Norris noted that it is standard practice to integrate the treaty agreement into the licensing conditions as the treaty takes precedence over national laws. Another participant questioned the use of PSM to control nationals in addition to flagged vessels. Mr. Norris responded that the situation is complex, but there are specific provisions in the conventions for flag states to ensure vessels (and individuals) are doing the right thing. Another participant queried whether the PSM would address some of the issues with the High Seas. Mr. Norris responded that transhipment at sea and on High Seas represents a huge risk for fisheries and contributes to other illegal activities. Mr. Norris remarked how the FFA sees interesting interactions between vessels when looking at VMS and AIS on screen, but that it is difficult to detect what is allowed and what is not as current legislation and regulation in this area is poor at defining these interactions. He concluded that the region needs to improve legislation and regulations and then assess the legitimacy of activities they are observing on the High Seas and elsewhere through the RSP.

Summary

Throughout the session on Current Technology Capabilities and Limitations participants reviewed current technology capabilities and challenges and the experts provided some suggestions of how they envision things moving forward. Questions raised include how providers' proposed technologies might fit into improving communications. Participants acknowledged that satellite technology and electronic surveillance in recent years have had a huge impact on understanding fleet dynamics and their compliance with rules and regulations with AIS playing a role but requiring improvement. Participants observed how technological advancements have already had an impact on the entire surveillance picture from paper trails to boarding and inspections. However, the session chair raised an important question regarding the new and increasing data streams that require analysis, recommending that firms such as Google Analytics and SAS (aka "Big Data") are designed to specifically deal with large streams of data sources to allow the data to be compiled and used more effectively. Participants observed in the presentations how efficiencies in technologies are increasing, which requires managers to respond to keep pace with these advancements.

Presentations showed how some measures, like ASBI are costly in terms of time, effort and expense, so managers need to look at ways to deploy people more effectively. Moreover, deterrence alone may not be enough, so there also needs to be action. Techniques to achieve this could be drawn from existing techniques and procedures as well as engaging with technological advances.

Managers must consider how to put together a complete MCS infrastructure package to achieve goals. For instance, they must consider the best options for aerial surveillance such as leased aircraft in the "Sea Dragon Project", which could be used more effectively than UAVs at this time. The main point to remember is that while technologies may not be 'ripe' presently, they will only improve with time. It was acknowledged however, that technology might not be able to improve on simple solutions such as vessels directed to port through PSM, which makes it much easier to identify potential illegal fishers. Additionally, the proportion of effort associated with how to achieve goals collectively rather than individually needs consideration, noting there will always be a need for national and regional level implementation.

Summarising the State of MCS in the Region

Introduction of MCS Matrix

Mr. Apolosi Turaganivalu, FFA Compliance Policy Officer, provided a presentation on the MCS Matrix. The MCS Matrix represents one of the primary tools to help determine and define the FFA RMCSS. The MCS Matrix extends from studies commissioned in 2007 to develop the initial RMCSS and consists of a "traffic light" system designed to look at identified components and performance indicators by member states.

Mr. Turaganivalu remarked that the Workshop presented a relevant and timely opportunity to review the MCS Matrix as the FFA enters development of its new 5-year MCS Strategy. Because the MCS Matrix identifies gaps in MCS implementation, it provides an opportunity to consider where emerging technologies might play a role. Lastly, he noted that efforts to implement NPOAs for IUU measures at a national level for several FFA member states will have an impact on their assessment under the MCS Matrix.

PANEL: The MCS Matrix

WWF convened a panel discussion to address the MCS Matrix including the following panel members:

- Mr. Maurice Brownjohn, the Commercial Manager of the PNA
- Mr. David Karis, VMS Manager, Papua New Guinea
- Mr. Samasoni Finikaso, Director of Fisheries, Tuvalu

Mr. Brownjohn was quick to point out that secondary benchmarks are needed even with the MCS matrix. He claimed it was hard to believe the compliance figures are valid, particularly with regard to observer coverage as purse seine has 100% coverage. He expressed a need to further understand the segment targeted and definitions used by market states to push their agendas, expressing that the concerns regarding IUU could be more a measure to create work for consultants than anything else. He further questioned the Pacific strategy for negotiating in the region and whether the MCS Matrix is prefaced on information about IUU and if so, whether that information is relevant and the role that NGOs play. Lastly, he expressed that there needs to be a standard definition of IUU and benchmarks to move forward or, rather, to first answer the questions of "What is IUU?" and "What is the scale of IUU?"

Mr. Karis stated that the timing is right to look at the MSC matrix review, especially for Pacific Island countries (PICs) in line with reviewing or developing their SOPs and aligning it with the management aims for compliance. He noted that for PNG, the electronic vessel registration, which is a market driven application, along with VMS integrated into one platform for real-time or near real-time information, represents a good marker for improvement. Mr. Karis also noted that clients want to enable login to the MCS centre for information on officers, persons on board, vessel schedule, and other things, but also noted that improved broadband access to near real-time information is necessary to facilitate better enforcement.

Mr. Finikaso pointed out that from the point of view of Small Island Developing States (SIDS) like Tuvalu, a review of the matrix is very timely, as some have not been completed due to a host of challenges since 2010. He remarked upon the surprisingly high number of components that were in the "red" or "weak" category and expressed a need to review and prioritise these MCS issues. Lastly, he noted the regional discussion on PSM and the fact that the NPOA for IUU is proceeding in Tuvalu, making this discussion relevant.

In summary, the panel indicated that the review is timely and relevant. They emphasised that FFA should investigate the definitions of IUU in relation to what constitutes IUU and how to quantify scale, noting that IUU is inherently not

easy to quantify and some figures touted in the past raises questions about method used to arrive at these figures. They agreed that each member state must effectively address obligations for information sharing and voluntary compliance because collectively, the region can paint a clearer picture of what is happening in the region when information is effectively shared. Lastly, they noted that there are obligations associated with the matrix now, but these are not clearly outlined and recommended that FFA needs to link the assessment to tasking.

The discussion that followed among participants was very lively and engaged. Mr. Bubba Cook enquired if the VMS achievements effectively address obligations under the MCS Matrix. Mr. Karis noted that in the past 2 years, PNG has achieved voluntary compliance, accomplished with sharing VMS data with other fishing partners, adding that in PNG companies now employ their own VMS officers and come to the national administration for reports. He further emphasised the importance of sharing data, in part because it allows individual vetting of data that saves a lot of time for national officers.

Mr. Mark Young noted that improving voluntary compliance by sharing VMS data with vessel owners could push compliance to then reach 70% which would go a long way toward helping members reach their targets.

Mr. Young also noted that the matrix is subject to self-assessment, with the FFA asking members to update their components online annually and provide feedback to FFA. The objective criteria with performance indicators for each component have a scoring methodology to determine colour-coding as weak, moderate or strong. The clear criteria make the self-assessment objective.

Mr. Cook noted that these discussions on MCS components are potentially missing one of the most important aspects – people. He emphasised that member states need to ask whether there is enough human capacity to manage the new and growing data streams associated with new technologies and, more importantly, that training and education opportunities are available.

Mr. Karis noted that there is also a need to add a catch documentation scheme (CDS). He noted that PNG has an NPOA for CDS especially for the EU market to see catch origins, even if offloaded to carrier vessel, before being unloaded in port for flight out. He pointed out that while this is a new tool, it is the kind of innovation that must become more commonplace in the future.

Mr. Mark Oates furthered Mr. Karis' statements by pointing out that an effective CDS completes the MCS system. He remarked that the region has boundaries with some data shared and some not, which leaves a big scope for lack of reporting, especially when a vessel leaves a country's waters and they are not obligated to report to that country. Mr. Oates emphasised that timeliness and completeness of data is important to CDS.

Mr. Mark Young also pointed out that the availability of data for near real-time reports needs timely and complete links to the Information Management System (IMS), especially from an MCS and fisheries management viewpoint in order to promote better informed decision-making. He noted that data underlies every MCS component for members who need this at their fingertips to make decisions.

Ms. Kerry Smith remarked that the increasing amount of data now presents a problem because the impact of extra data on smaller administrations has become an issue. She also noted that sharing information across the region is as important as sharing information across ministries, departments and divisions within countries, as this could even encourage other national agencies to enforce their laws.

Mr. Brownjohn pointed out that transparency of data presents a significant issue, especially with the establishment of MOAs with other national agencies. He pointed out the example of fish that comes in on containers while fisheries departments do not have access to this data, thereby preventing them from maintaining accurate records. He agreed that timeliness of data should be addressed because time lags impact analyses on which management decisions are made. Lastly, Mr. Brownjohn noted that harmonised benchmarks exist to a certain degree in the region, but at a global level, other parties make decisions regarding your level of compliance such as the current EU IUU assessments. He noted that the opinion of these other parties on PIC compliance impacts the region if there is not an internationally agreed benchmark.

Mr. Cook asked again if members have the capacity to manage and share information or if this is another strain on the human/personnel capacity to adequately perform. He acknowledged that this area is a big gap, especially for smaller administrations where personnel do multiple tasks.

Mr. Brownjohn emphasised that capabilities in the region are limited and as a result, the additional cost of MCS efforts may not be effective unless adequately enforced, questioning how we deal with that disparity.

Mr. Young suggested that member states cannot solve all their problems individually, so it requires regional cooperation and support for SIDS. He pointed out that collective action could reduce the costs and burden of capacity development if an agreement is reached and that regional cooperation is very important for all MCS measures.

Responding to a question about the WCPFC's position on the MCS Matrix, Dr. Lara Manarangi-Trott said the matrix is an FFA member tool. However, she noted that one piece of work at WCPFC on compliance involves the number of FFA members in need of raising their ability to monitor fisheries as flag, coastal and export states. She noted that coastal and flag state responsibilities need to be discussed a lot more and that once FFA members become a flag state they need to dedicate staff, provide communications protocols to captains of the vessels flagged in their state, maintain observers on board with VMS coverage, and cover all the additional reporting obligations as well as respond with follow-up to any wrongdoing found by other states. She also noted that the list of red on the matrix is a growing area for FFA members and while it is legitimate to take on more vessels, there are more obligations that come with that decision and countries continue to fail in their reporting responsibilities. Lastly, she recommended that a further iteration of this matrix could flesh out the individual responsibilities more.

Mr. Peter Smith of Aerosonde pointed out that in considering the MCS Matrix, he was already starting to see where technology could play a substantial role in achieving improvements in the component evaluations. He noted that on board inspections could be conducted without actually having to board the vessels using real-time high resolution video with UAVs, also pointing out that UAVs can be sent virtually anywhere in the Pacific while sending data to multiple locations. Lastly, he pointed out that providing real-time data to multiple locations allows the ability to react effectively with a coordinated response and that the technology already exists to do so and can be readily integrated into the existing MCS infrastructure.

Summary

The MCS Matrix components are relevant in determining where risks are in the regional MCS framework and how we might employ sound methodologies to conduct good assessments on regional efforts to address MCS implementation. The MCS Matrix indicates that there is room for growth/modification to accommodate changes in the region over the years. Electronic CDS could benefit from more discussion as well as SOPs, data sharing MOUs, general risk assessment, and the importance of tying it all into the MCS Matrix. FFA and the member states can then make links between the issues and areas of concern to potential tasking to address these areas of risk. Nonetheless, it is important to understand that no one size fits all solution and the possibilities of technological advances are welcome.

Day 2: The Technologies

Readers are strongly encouraged to review the presentations found at:
https://drive.google.com/folderview?id=0B79T78ZKDRNiV1Y1NkJjRF83blk&usp=sharing

Autonomous Surface Vehicles (ASVs) and Ocean Sensor Technology

Innovation in Ocean Robotics

Mr. Todd Kleperis of Liquid Robotics, Inc. gave a very engaging presentation on the use of various ocean robotic technologies that are currently available or will be available in the very near future. Some of his key messages included:

- Robotics are here.
- They work without people.
- Yes, you can use them now.
- Wherever you want to go, technology can help you get there.

Mr. Kleperis not only introduced the Wave Glider, which has potential applications as a cueing tool for a broader MCS suite, but also provided information on a variety of other marine robotics applications that are of interest to fishery managers. For instance, he suggested that the Wave Glider is not a tool to necessarily look for targets, but as a listening device it can be very effective when used in conjunction with UAVs by alerting them to a target area, noting that it can take photos or video, but that uplink costs are a factor. He specifically noted how Wave Gliders can act as a force multiplier with a single pilot for dozens of devices collecting data, also noting that you can determine how you collect, analyse, and apply the data. Lastly, Mr. Kleperis acknowledged that there is no one size fits all, but that the Wave Glider system can be modified to suit any situation, as it is capable of carrying a variety of payloads and that there are multiple options for implementation including leasing options.

The engaging presentation sparked some substantial discussion. After viewing the large industrial mining robots, one participant aired concern that Sea Bed Mining (SBM) lacks a mechanism of Minimum Terms and Conditions (MTC) that exist for fisheries in the region and that there is a desperate need to develop MTC and environmental conditions

for SBM. He added that putting robots in the sea amounts to deployment of more FADs and it is likely the industry will target them, pointing out that approximately 30,000 FADs are already deployed around the Pacific with buoys that provide some basic information on monitoring sea quality conditions like water temperature. He suggests, for fisheries management, that using Wave Gliders to enhance the tracking of FADs and increasing information relays could be of benefit.

Fastwave Ocean Sensor Technology

Mr. Phil Sarich of Fastwave Communications Pty Ltd, provided a very interesting presentation on a variety of marine data acquisition systems. Of particular note were the Pathfinder and Voyager Self Locating Data Marker Buoy (SLDMB), which offer a low cost, retrievable, and reusable option for FAD tracking. Mr. Sarich also described the hydrophones used in some configuration that could be used for vessel detection in an MCS application that is part of a Networked Data Acquisition System. Additionally, he described the Iridium Nano Messaging & Tracking device, which has potential applications for tracking small vessels. Lastly, he suggested several applications that Fastwave may be able to support efforts in the region including:

- Wave Gliders for persistent surveillance & queuing of targets
- Devices / Sensors to acquire key data without human intervention e.g. Catch Weight
- Accumulation of data & real time transmission
- Distribution of data direct to agencies
- Low bandwidth communications

Discussion was generally limited to the use of the buoys as FAD tracking mechanisms.

OCIUS Bluebottle ASVs

While originally unscheduled, Dr. Colin Shelley of the University of the South Pacific offered a presentation on a company employing solar technology in a marine context. The Bluebottle ASV system offers a similar persistent surveillance option to other ASVs, such as:

- Self-propelled and self-deploying/retrieving using solar/wind/wave/ballast;
- Autonomy with anti-avoidance/sensory informatics;
- Constant communications with most cost-effective data transmission plus ability to carry payloads;
- Able to stay at sea for many months and to withstand the harshest weather conditions.

The Bluebottle presentation illustrated how solar and battery technology is quickly advancing to support more sophisticated roles in marine surveillance.

Full Catch Documentation Based E-logbook and E-reporting

Mr. Mark Oates of Quick Access Computing Pty Ltd, Australia, gave a very intriguing presentation on the Fisheries Information Management System (FIMS), a system that utilises a unique delivery platform incorporating tablet computers. Mr. Oates noted that he has engaged development of the system in the South Pacific for approximately 5 years, noting that some of the unique features include:

- Purpose built system;
- Built in error tracking;
- Multiple levels of verification; and
- Capable of being fully integrated/incorporated into other systems;

A participant asked if the system was voluntary or mandatory as well as how it was funded. Mr. Oates responded that it is largely industry funded with a significant vested interest as it costs less than half of one day fishing to subscribe for a year which funds ongoing development. He also noted there were some components being funded by NGOs. The same participant asked why Samsung was chosen as the tablet platform as opposed to one of the other tablets. Mr. Oates responded that they recommend Samsung as part of the android technology. He noted, however, that reliability depends on better quality devices for their purposes which last longer, yet while Apple lasts longer costs are a factor in addition to challenges with uploading apps for Apple through the Apple Stores makes things more complicated.

Several other participants expressed an interest in using the platform to facilitate data sharing, pointing out the ease of automating other reports and data entry with the system. Mr. Oates responded that SPC is already developing North Atlantic Fisheries (NAF) format for data loading and has gone ahead with data captured in this format and Quick Access Computing (QAC) is already considering developing separate buttons to send different information between countries that would allow for efficient and organised transfer of data in the region.

Electronic Monitoring

Satlink: Ecolog System

Mr. Egor Zavorovskiy, of SATLINK offered a comprehensive presentation on the Seatube electronic monitoring system, which includes:

- Onboard Video Recording System;
- Fishing Trip Analysis Software for land analysis; and
- System Status Reporting and Monitoring Service via satellite

Mr. Zavorovskiy noted that the core of the unit is a VMS solution, which reports every 10 minutes and stores information locally on hard drives. He also noted self-diagnostic and anti-tampering features of the system. Additionally, he announced that Satlink was already working with FFA and had installed its system on 2 vessels based out of Honiara as part of a pilot project.

One participant expressed concerns about the ability to integrate this new data stream into the overall MCS infrastructure and how it will be maintained, expressing the need for rules and procedures for the storage and dispensation of video records.

Archipelago: Electronic Monitoring Programmes

Mr. Adam Batty of Archipelago Marine Research provided a comprehensive presentation on the Archipelago EM solution. He specifically noted Archipelago's status as a pioneer in the development of the use of cameras in marine surveillance with over 35 years of experience. Using an iceberg analogy, he specifically noted that the actual equipment is just a small part of the overall system that you see. Mr. Batty pointed out recent trials in the tuna purse seine fishery in addition to making a clear connection between the Archipelago EM solution and the FFA MCS Matrix components. In closing, he noted that:

- EM offers a specific focus on the "unreported" of IUU;
- Technology represents only one piece of the EM solution with programme design being very important;
- Archipelago encourages a clear, objectives-based deployment; and
- EM provides the basis for an effective information system.

A participant asked about the ability of the software to conduct length measurements. Mr. Batty responded that the software can measure nose to tail accurately to 1-2cm. Another participant enquired about the cost compared to human observers. Mr. Batty replied that the cost depends on the programme design and the regional rates of pay for observers. He also noted that the cost and data accuracy also depends on the type of data collected. Lastly, Mr. Batty noted that, as an observer provider themselves, Archipelago acknowledges that EM might not be right for all situations and that human observers could provide the better option.

Electronic Monitoring Trials on Tuna Longline Vessels

Mr. Malo Hosken, a consultant for Secretariat for the Pacific Community (SPC), gave a brief presentation on an EM trial he was assisting in the Solomon Islands. He noted that the following features that comprised the EM trial:

- HD Cameras: Fixed, autofocus, wide angle
- Covers shooting, hauling and processing
- Satlink Sea Tube + FB250 + VMS
- Tamper proof system – recording 24h
- Footage and data is encrypted and backed up

Additionally, Mr. Hosken pointed out that one of the primary components of the trial included a comparison of the efficacy of the EM system by also having a human observer on board collecting information.

Unmanned Aerial Vehicles (UAVs)

Mr. Peter Smith and Mr. Maurice Gonella of Aerosonde provided a combined presentation on the use of UAVs or "drones" in an MCS context. Mr. Smith offered a very interesting review of the history of drones from their humble beginnings in World War I to the current civilian applications. He emphasised that the UAV system is no longer an experimental technology and offers the following potential in the South Pacific:

- UAS can provide a major enhancement of situational awareness for EEZ protection;
- UAS technologies are now at high levels of reliability;
- UAS provide a safer option for airborne surveillance than manned aircraft;
- UAS also provide much longer endurance surveillance and monitoring;
- Uniquely, UAS can monitor vessels covertly, not seen or heard with deterrent effect;
- UAS can operate independently or with other MCS assets;
- UAS can integrate data into existing fishery management systems and accept data from them;
- UAS systems have a large element of autonomy, simplifying operations;
- UAS are affordable, particularly as their operations transition to Pacific nationals; and
- A common, adaptable UAS system model can be provided for all FFA nations.

Mr. Smith further elaborated on the cost effectiveness and affordability of the UAS system, noting that it can be used as a multipurpose platform and that there are several operational models that do not require you to purchase the unit.

Mr. Gonella offered an overview of the recent trial of the Aerosonde in Palau. Additionally, he proposed the following recommendations or considerations for UAV use in the South Pacific:

1. Locations - Base in national capital, giving access to government agencies, support infrastructure. Subsidiary bases for launch/retrieval to extend patrols;
2. Overall Air/Sea System and Procedures - Integrate the UAS operations and their data inputs into existing FFA manned air and sea systems, tailored for individual national operations;
3. Organisational Reporting - Integral part of Maritime Surveillance authority of each nation;
4. Air Vehicle - Base on the Aerosonde Mk 4.7.J, giving low cost, long endurance, reliability, multi-role versatility;
5. Ground Control System - Locate the en route ground system at Maritime Surveillance authority HQ, integrating with FFA, VMS and other systems;
6. Launch and Retrieval - Use automatic launch of LRT (launch & retrieval trailer) for simplest, safest operations; easily transportable to alternative locations;
7. Sensor/Communications System –
   a. Remote video terminals on vessels and remote bases
   b. Optimise system for wide area surveillance, particularly under low cloud base
   c. Consider Kestrel Maritime Software to reduce imagery monitoring;
8. Complementary Intelligence - Maximise use of local intelligence from islands, legal fishing vessels, communications/radar intercepts to cue UAS missions; and
9. Secondary Roles - Make UAS available for secondary roles to offset costs.

The presentations solicited a robust discussion. One participant questioned how reliable the aircraft are. Mr. Smith responded that only one has been lost operating a 17 hour mission in Antarctica due to a rubber belt that failed in -40C temperatures. Another participant asked about the portability of the units. Mr. Gonella responded that the full sized model they brought to the workshop weighed 32kgs and was brought as luggage on the flight to Honiara.

Another participant asked whether there was a possibility of expanding the range of the UAVs and whether they could be used to identify FADs at sea. Mr. Gonella noted that the units currently have a 120km range, but that the technology is continually improving. He also pointed out that the aircraft can carry a variety of payload sensors and that while the cost of delivering data becomes an issue, they are working on pre-processing data in a way that could

reduce data and cost demands. He noted that FADs are harder to see on the water, but that there is new technology that can distinguish colours and other differences on the water, including SAR.

Integrated Satellite Monitoring Technology

Mr. David Martin of exactEarth provided a presentation on the use of Integrated Satellite Monitoring in MCS applications. He noted that while satellite technologies offer some good solutions, it still faces some challenges such as the fact that no single sensor provides a complete answer, noting coverage and persistence is challenging for some (Radar, Imaging), and others depend on vessel self-reporting systems (VMS, AIS), but also pointed out that a combination of sensors can help identify non reporting vessels. Mr. Martin provided a good overview of the AIS technology and how exactEarth's system can help improve the RSP. He noted the strength of combining AIS and SAR to identify "dark targets" that could be committing IUU. He also pointed out that AIS implementation on fishing vessels is increasing at a rate of 15-20% a year with China aggressively adopting AIS. Lastly, he noted the development of a compact, cost effective modified AIS Class B transponder that should be available in 2014 for commercial applications, which could easily be used on the smallest fishing vessels.

The discussion that followed focussed mostly on the technical and cost factors associated with AIS. One participant asked about how AIS information is received through satellites and by vessels. Mr. Martin responded that vessels can see each other not only by their positions but also their identity and other information like speed and destination, noting that around the Horn of Africa, military ships broadcast their AIS information as a deterrent and ships actually also include messages about armed guards on board to deter piracy.

Another participant asked about the cost of the units. Mr. Martin explained that the AIS units installed on board each vessel are only a few hundred USD each. Other participants noted that, unlike VMS, the cost of transmission is free, but that the data collected by the AIS satellites has an associated cost.

A participant asked whether AIS, in the absence of logsheets and documentary evidence, is enough to support evidence of a violation in investigations and court proceedings. Mr. Martin explained that the question is difficult to answer as it depends on the legal requirements of the country. Mr. Martin confirmed that that the technology is not tamper proof and some statistics show up to 30% is incorrect as it depends on what people enter into the transponder. However, he noted that regional administrations could be tasked with ensuring transponders are under more stringent monitoring and controls.

Another participant wanted to know how often AIS information is transmitted and available for analysis. Mr. Martin pointed out that AIS was never meant to be real-time like VMS, but can be used to verify and validate other data sources. He added that it is really useful especially when other data is cross-checked with satellite imagery.

One participant asked about the power requirements for the AIS transponder. Mr. Martin explained that the power demands are only 2 Watts and broadcast with special message format.

CMDR Mike Pounder cited an example where AIS used at the FFA Fisheries Regional Surveillance Center was tracking vessels during an operation and, in an effort to keep the information clean, officers put up both AIS and VMS data. They discovered that some vessel identifiers were different as indicated by VMS and AIS. After doing some intelligence research it was discovered that a chemical tanker with the AIS signature was actually off Dubai at the time and it was actually a genuine fishing vessel posing with the AIS data from the chemical tanker.

PANEL: Implementation Requirements for MCS

WWF convened a panel discussion to address the MCS Matrix including the following panel members:

- CMDR Mike Pounder, FFA Surveillance Operations Officer
- Mr. Peter Smith, Aerosonde
- Mr. Todd Kleperis, Liquid Robotics, Inc.

CMDR Pounder initiated the panel discussion by stating that in his three years as the Surveillance Operations Officer (SOO), the big lesson learned from 17 members in FFA is that there are more than 100 opinions on how to do things in each one of the member states, so it presents a "mine-field" to wander through. He noted that how the technologies are implemented is difficult to gauge amongst 15 island members of FFA with different sets of problems and priorities. He suggested that many of the smaller nations have different problems compared to larger nations with more money to spend.

A participant agreed and remarked that the dynamic between the smaller and larger states is similar to having a single crab in the bucket, which will climb out given an opportunity, but if there are a bunch of crabs they pull each other back down into the bucket – likewise for regional cooperation.

CMDR Pounder responded that regional efforts cannot be all things to all members all the time. He recommended that looking at various technologies and cost effectiveness and the different effects that individual nations want along with the various ways that different technologies are applied will likely result in more details on systems' impact and effect. However, he also pointed out that if technology that could be deployed, you might see the greatest immediate effect in smaller EEZs within 90 days, but that the longer term would present different results. CMDR Pounder suggested starting with smaller nations on situational awareness as the 'low hanging fruit'.

Mr. Kleperis asked the participants if, as a small island state with a large EEZ, would the technology be purchased by the government. He noted that in the case of ASVs, the cost of a robot is USD$500,000-700,000, so if the value of the fishery is USD$1.5 million then spending half of what is earned on technology alone is not practical. He proposed that interested states do not have to purchase the technology, but can simply allow the company to operate the system, suggesting that there is a way to get the information the small island states need for free in this region.

One of the participants asked what messages Workshop participants would take home to their respective countries as well as into the MCS WG. He stressed the need to know what it would cost a national Government or the region, as well as understanding what trade-offs need to be made to get hold of this information.

Another participant noted the need to understand the size of current returns on fisheries today and costs to implement solutions. He pointed out that if we are to implement these technologies we need to know what the return is on the investment, so we need to know up front what the objectives are to get there and what technologies are best placed to get us there.

Mr. Smith remarked that on the cost side of UAVs, customers don't necessarily want to buy infrastructure and set up facilities as they attempt to evaluate the system. He noted that there are different cost models such as charging by hours flown, by number of photos used, et cetera as criteria instead of spending large amounts up front. He concluded that "people want to understand before they make a commitment to buy."

A participant emphasised that an alternative regional approach might make more sense than a national one.

Mr. Smith suggested that it seemed to make sense that a lot of aspects in fisheries MCS can be pushed from national to regional or subregional. He pointed out that statistics on PPB gifted by Australia as number of days at sea are pretty woeful and more often than not they sit alongside a wharf being maintained. He proposed a regional asset linking Aerosonde with PPB, where a regional asset can do a percentage of sea days in each PIC amounting to larger use of this asset. Mr. Smith pointed out that exercises can be done through the appropriate use to assets as a regional deployment. He recommended choosing simple locations and a focus on subregions such as Micronesia, Melanesia and Polynesia as central locations might get better results.

A participant emphasised that there needs to be inventory of what risks are calculated by area, noting that maybe the purse seiners have lower risk as they are monitored more. He suggested that parties look at cost/benefit of addressing risk and deemphasise those that are lower risk.

One participant asked about the legality of EM and use of cameras, particularly how they are treated in different statutory systems and how they may be used across these different systems. This led another participant to question the uniformity of information availability and dissemination. Mr. Kleperis suggested that information could be distributed through existing regional agreements in the case of the Wave Glider.

Another participant queried the legal restrictions on flying UAVs through different jurisdictions. Mr. Smith responded that there used to be restrictions via IATA, but these restrictions have since been reduced such that only cameras come under IATA which can be overcome by using a non-US camera.

When further questioned on the economics of the UAVs, Mr. Smith emphasised that we need to better understand the cost-benefit approach before saying anything about costs of UAVs, pointing out that potential benefits of accumulated statistics such as possible losses regionally or globally are helpful, but there is very little data on losses accrued by individual nations. He noted that if there are sources, then could have a more quantified discussion.

CMDR Pounder further emphasised that we do not know what we do not know and while he has seen various figures touted, he spent weeks trying to find a number from 10 – 28 billion. He also pointed out that the determination for each country depends on data from SPC that has yet to be quantified for each EEZ as a value.

A participant pointed out that the value of purse seine fisheries is about USD$3B, with IUU value being relatively small due to 100% observer coverage of purse seine. He questioned whether the longline fishery, which operates largely in the high seas, had an estimate for the value of the fines in each country. He expressed that maybe a question for WCPFC is to determine how EM information can be used in prosecution and to also consider requiring vessels fishing in high seas to carry EM.

Several participants considered having other measures and mandating EM technology to be on board certain vessels. They noted a need for agreed conditions, parties, and a start date with prescribed minimum specifications that would be acceptable. One participant suggested an option that would require industry to bear the full cost of implementing an EM system if you fail to reach 5% observer coverage and also, if a vessel is found to have violated a CMM they are required to carry an EM system.

Another participant emphasised that the EM technology, while promising, cannot replace human observers for many tasks. He noted also that it would be important to ensure that trained observers are not only consulted with any design elements of an EM system, but should also be tasked with monitoring and reviewing information collected using an EM system. Another participant noted that observer programmes form a significant source of employment in many small island states.

A participant then queried how many successful prosecutions the WCPFC has engaged on the high seas. Dr. Lara Manarangi-Trott responded that the WCPFC does not possess enforcement powers, so can only write to flag states and encourage them to enforce the CMM.

Several participants suggested closing the high seas, especially the high seas pockets, as an easy way to address some of the MCS challenges and queried whether countries would be receptive to contracting out surveillance and enforcement.

One participant stated that longliners prefer to stay on the high seas, but that most states would prefer them to come into their respective EEZs to facilitate more effective MCS and thereby reduce IUU. They noted that if the high seas were closed there would be better economic benefits for the licensing states.

A participant pointed out the difficult implementation challenges for smaller administrations and that while it appears these technologies will help, cost will continue to be a factor. Following from this comment, another participant noted that EM could be useful due to the difficulty of recruiting observers to work in difficult situations like on some longline vessels. He further explained that the ability to verify species and sizes through reviewing video is a job that can be done with the right people to monitor and review the EM information. He then pointed out that wages for observers or EM reviewers must be seriously considered, noting that unlike the nature of the observer job, which is part time only and in a difficult environment, EM reviewers could become full-time employees working in a more comfortable environment.

One participant remarked that each time new technology is introduced, the cost is a primary factor for the small island states. Another participant pointed out in contrast that we need to start somewhere, so the small island states should put all these technologies together then see what addresses the needs at minimum or no cost.

A participant noted that UAVs flying over and taking footage could provide tremendous evidence to be used in court, which could be very useful.

A participant emphasised that member states must observe coordination in terms of broader MCS tools and how they can integrate to work together. He noted that the regional authorities must look at the whole suite of tools and that no one size fits all solutions exists. He further emphasised that the application of these techniques and technologies will differ significantly among states, especially with respect to monitoring, capacity, and development. He concluded that a highest benefit would likely be to expand monitoring capability as a regional solution.

A participant asked about the resolution capability of cameras on drones. Mr. Gonella responded that Aerosonde can achieve a 6m distance on gap from about 1km away from vessel with medium range camera with high zoom, but that a more expensive camera does twice that zoom and you can fly closer if you don't mind people seeing you.

Another participant suggested that, from the perspective of a country with well-developed IMS, they are looking at a maritime surveillance centre with support from NGOs. He also emphasised the need for working together to bring technology to the region and support smaller countries as well as to agree on format and file types according to NAF standards so that we can talk the same language on computers and in databases.

One participant noted the practical approach of considering a hybrid system to utilise AIS, VMS, and radar to identify IUU as a potentially important part of the toolkit for the region. CMDR Pounder noted that there are lots of tools out there to do the job, but that much of the analysis is manual and automation can only serve to improve efficiency. He noted that when AIS was first used by FFA in 2012 we were able to see 25% (now, 30%) more vessels. He noted the growth of AIS around the world as a licensing requirement in other regions and suggested that FFA members consider making AIS part of the licensing condition. CMDR Pounder also noted the potential use of AIS as a redundancy mechanism or backup to VMS, especially with regular failures either with equipment or signal for VMS, noting that it is harder to keep track of manual reporting when VMS fails.

One participant emphasised the need to prioritise costs and affordability based on fisheries income over a five-year period. He noted that basic studies show that EM is relatively inexpensive when compared to human observers and provides a cheaper solution while also providing jobs in the form of video reviewers. Another participant replied that costs also need to be assessed against savings considering human observers vs. EM technology.

A participant suggested that if any of the technologies should be feasible, a cost recovery mechanism should be developed to support implementation. Another participant responded that despite repeated and various calls for cost recovery, there are complaints, particularly from the longline fleet, that cost recovery would be too expensive and they sometimes view these requirements as unjustified. Another participant pointed out that cost recovery is complicated because some PICs do not always ensure cost recovery fees actually come back to fisheries from treasury due to challenges in systems and processes.

A participant lamented that despite a longstanding requirement for 5% coverage on long line vessels there is currently barely 3 – 4 % and not even near that on most vessels of concern. He expressed that it seemed like an easy proposal to place EM on vessels because of the lower burden on the industry with respect to housing them on board the vessel, but noted that there will still be a need for human observers.

Mr. Smith concluded the comments in the discussion by stating that technology may not necessarily put people out of a job, but could rather build capacity to observe through video especially if they are experienced and can notice anything out of the ordinary. He pointed out that technology is complementary and possibilities are endless, noting that results from the UAV trial in Palau were not immediate and that it took several trips to understand their fisheries issues and how technology could assist.

Summary

The sessions included in Day 2 allowed technology and service providers to showcase their respective technologies while giving participants an opportunity to consider and question those technologies as a part of the existing MCS infrastructure. The Panel discussion drew out some of the substantial implementation concerns with the new technologies and also provided direction for other future considerations regarding new technologies.

Workshop Summary Outcome

Technology and service providers received the unique opportunity to review and understand the challenges and opportunities in the WCPO related to MCS applications as well as consider how their particular technologies might contribute to addressing some of those challenges. In turn, regional MCS experts were able to objectively review several emerging technologies as they might be applied in the region and assess their economic and practical viability. As a result, the desired outcomes identified on Day 1 were largely achieved by the workshop with the technology and service providers receiving a better understanding of the MCS needs of the region while participants achieved a better understanding of the emerging technologies and their capabilities. Most importantly, participants identified that several of the technologies are available and ripe for use in an MCS capacity in the WCPO region.

A survey was sent out following the workshop requesting feedback on the content, organisation, and outcomes of the workshop. Responses to that survey are included in Appendix C. Since the conclusion of the workshop, WWF was made aware that discussions and even potential projects and business relationships have moved forward between some of the technology and service providers, the FFA, and some member states.

Several overarching informational needs were identified by participants as necessary to move forward implementation of some of the emerging technologies including:

- A comprehensive MCS gap analysis;
- Basic cost estimates for each technology;
- An objective and comprehensive cost/benefits analysis of each of the current MCS measures as compared to the emerging technologies;
- An analysis of potential cost recovery models;
- A needs assessment reviewing the IT requirements of individual countries necessary to support emerging technologies;
- An economic assessment of IUU by separated by country and high seas; and
- A broad analysis of applications of various emerging technologies for MCS activities globally.

One significant knowledge and technology gap that has already been identified includes understanding how to deal with the dramatically increasing data storage and delivery requirements. WWF was unable to secure a commitment from a Big Data representative, but continues to believe that Big Data remains a critical technology advancement that should be explored and will continue to seek opportunities to bring in Big Data providers to explain how they might be able to help countries achieve their MCS goals and objectives.

Conclusion

WWF wishes to remark on the high degree of positive engagement, discussion, and commentary by all participants at the WWF MCS Emerging Technologies Workshop. The extraordinary degree of professionalism and expertise of the presenters was nothing short of impressive. Moreover, the forum offered a unique opportunity for participants to consider the technologies and their potential both within and between the plenary sessions that encouraged an open and inquisitive dialogue. Many participants positively remarked upon the value of the event and suggested repeating the event on a larger scale in the future. Several participants also suggested that the outcomes of the workshop be presented to the Scientific Committee (SC) and/or the Technical and Compliance Committee (TCC) for review and comment.

Appendix A: Final Agenda

DAY 1: Friday, 21 March 2014

08:00-09:00	Registration
Session 1:	Introduction
	Chair: Alfred "Bubba" Cook, WWF WCP Tuna Programme Manager
09:00-09:15	Opening Address
	Presenter: Alfred "Bubba" Cook, WWF WCP Tuna Programme Manager
09:15-09:25	Statement of FFA Deputy Director General
09:25-09:30	Prayer
Session 2:	Review of Current State of MCS Techniques and Technology
	Chair: Wez Norris, FFA Deputy Director General
09:30-10:00	a. Overview of Current MCS Infrastructure
	Presenter: Noan Pakop, FFA Director of Fisheries Operations
	i. National MCS Measures
	ii. Regional MCS Measures
	iii. FFA HMTC Regional Framework
10:00-10:45	b. Clarifying and Outlining Objectives
	Presenter: Alfred "Bubba" Cook, WWF WCP Tuna Programme Manager
	i. Clearly Identify Key MCS Objectives.
	ii. Identify and Refine Key Workshop Objectives.
10:45-11:00	MORNING TEA
11:00-11:15	c. Understanding Basic Gaps in MCS Framework
	Presenter: Apolosi Turaganivalu, FFA Compliance Policy Officer
11:15-11:45	d. International Cooperation
	Presenter: Wez Norris, FFA Deputy Director General
	i. Flag State Requirements
	ii. Port State Control
	iii. Global Record of Fishing Vessels
11:45-12:00	e. Discussion and Summary
	Chair: Wez Norris, FFA Deputy Director General
12:10-13:00	LUNCH
Session 3:	Current Technology Capabilities and Limitations
	Chair: Alfred "Bubba" Cook, WWF WCP Tuna Programme Manager
13:00-13:20	a. The Paper Trail – Written Documentation as an MCS Tool
	Presenter: Dennis Yehilomo, FFA MCS Analyst
13:20-13:40	b. Electronic Surveillance (VMS, eCDS, AIS, etc.)
	Presenter: Mike Pounder, FFA Surveillance Operations Officer

13:40-15:00 c. At-Sea Boarding and Inspection

Presenter: Mark Young, MCS Consultant

15:00-15:20 d. Manned Aerial Surveillance (overflights)

Presenter: Mike Pounder, FFA Surveillance Operations Officer

15:20-15:40 AFTERNOON TEA

15:40-16:00 e. Port State Measures

Presenter: Wez Norris, FFA Deputy Director General

16:00-16:15 f. Discussion and Summary

Chair: Alfred "Bubba" Cook, WWF WCP Tuna Programme Manager

Session 4: Summarising the State of MCS in the Region

Chair: Mark Young, MCS Consultant

16:15-16:30 a. Introduction of MCS Matrix

Presenter/Moderator: Apolosi Turaganivalu, FFA Compliance Policy Officer

16:30-17:00 b. Panel Discussion of the MCS Matrix

17:00-17:15 c. Discussion to identify key points raised, summarise and record key points raised

Chair: Mark Young, MCS Consultant

17:15 DAY 1 End

18:00-20:30 Welcome Function and Demonstration

DAY 2: Saturday, 22 March 2014

09:00-09:10 Opening Address

Presenter: Alfred "Bubba" Cook, WWF WCP Tuna Programme Manager

09:10-09:30 Brief Review of Day 1

Presenter: Alfred "Bubba" Cook, WWF WCP Tuna Programme Manager

Session 5: Overview of Emerging Technologies

Chair: Lara Manarangi-Trott, WCPFC Compliance Manager

09:30-10:30 a. Autonomous Surface Vehicles (ASVs) and Ocean Sensor Technology

Presenter: Mr. Todd Kleperis, Liquid Robotics, Inc.

Mr. Phil Sarich, Fastwave Communications Pty Ltd, Australia

10:30-11:00 MORNING TEA

11:00-11:30 b. Full Catch Documentation Based E-logbook and E-reporting

Presenter: Mr. Mark Oates, Quick Access Computing Pty Ltd, Australia

11:30-12:30 c. Electronic Monitoring

Presenter: Mr. Egor Zavorovskiy, SATLINK, S.L.

Mr. Adam Batty, Archipelago Marine Research

12:30-13:30 LUNCH

13:30-14:15 d. Unmanned Aerial Vehicles (UAVs)

Presenter: Mr. Peter Smith, Aerosonde Pty Ltd

Mr. Maurice Gonella, Aerosonde Pty Ltd

14:15-14:45 e. Integrated Satellite Monitoring Technology

Presenter: Mr. David Martin, exactEarth Ltd.

14:45-15:15 AFTERNOON TEA

15:15-16:45 PANEL: Implementation Requirements for MCS

16:15-16:45 f. Discussion to identify key points raised, summarise and record key points raised

Chair: Lara Manarangi-Trott, WCPFC Compliance Manager

16:45 DAY 2 End

Appendix B: Guest Speakers

Mr. Todd Kleperis, Senior Vice President, Liquid Robotics, Inc.

Mr. Kleperis is best described as an entrepreneur, Asian-based executive with a love of new technology. He holds a degree in Entrepreneurship from Babson College. Having lived in Asia for over a decade, Mr. Kleperis joined Liquid Robotics after the acquisition of his previous firm IContain. As Founder and CEO of IContain he launched the company from Hong Kong and grew it into the industry's largest supplier of remote device management (M2M) in three short years. Previous to IContain he was President of Sky Detectives, which designed and built tracking devices for security professionals and government agencies. A very keen interest in robotics has been a passion for Mr. Kleperis, having built his own land-based remote robotic systems. It was a natural fit to combine his love of the ocean with water centric Wave Gliders that cover the globe today.

Liquid Robotics is an ocean data services provider and developer of the Wave Glider®, the world's first wave powered, autonomous marine robot designed to help address the biggest challenges the world faces, including global climate change, national security, hurricane and tsunami warning, and offshore energy and resource management. The presentation at this workshop described innovation in ocean robotics and was titled "How Robots are changing Ocean Exploration."

Mr. Philip Sarich, Director, Fastwave Communications Pty Ltd, Australia

Mr. Sarich is the head of Operations at Fastwave. His vast experience in ICT for Nokia, Nuclear Electric UK and his current ongoing GIS engagements with marine science organisations in Australia and aircraft operators in the Middle Eastern conflict regions keep Fastwave on its toes to deliver secure, reliable and continuously improving enterprise services.

Fastwave has a solid track record of building and supporting marine data collection and telemetry systems. Fastwave develops integrated remote asset monitoring, control and tracking data acquisition systems for industrial, defence and research applications. The company focuses on providing global, real-time data availability and asset visibility for organizations by integrating remote sensors and instrumentation with global satellite telemetry systems and online data access and management solutions. Fastwave systems predominantly use the Iridium satellite communications network.

Fastwave has developed innovative data acquisition systems for fixed and mobile platforms for Land, Air, Sea Surface and Sub-sea applications. Fastwave's client base spans the oil & gas sector, vessel and aircraft operators through to science organisations operating in remote inaccessible locations.

Fastwave's portfolio of products includes such devices as marine water quality monitoring systems with near real time telemetry, GPS tracking buoys, vessel trackers and broadband telemetry buoys. Fastwave distributes and provides local support for Liquid Robotics, Inc., autonomous, robotic Wave Glider® as well as passive acoustic monitoring systems for sea mammal monitoring applications.

Fastwave's presentation introduced the company's portfolio of innovative technologies in the area of marine environmental and subsea data acquisition systems. The presentation illustrated some examples of the systems Fastwave builds themselves, those they integrate into their systems, and standalone systems which they distribute.

Mr. Mark Oates, Manager, Quick Access Computing Pty Ltd, Australia

Mr. Oates possesses a background in Accounting and Electronic Data Management, IT Systems Management, and Training. Most recently, Mark has provided ongoing training and support on the Fisheries Information Management System (FIMS) to the Papua New Guinea National Fisheries Authority (NFA) and Parties to the Nauru Agreement(PNA) for over 5 years.

Quick Access Computing (QAC) maintains a highly intuitive, dynamic team committed to producing results through computing technology. QAC provides a full end to end service to clients that includes network administration, system administration, hardware support, operational support, software development, and data protection.

QAC has developed a system for near real time electronic activity and catch reporting by tuna purse seine vessels, using the iFIMS for the Papua New Guinea National Fisheries Authority (NFA). The iFIMS system provides catch and effort data available for VDS Validation, Catch Documentation Schemes (CDS), and Marine Stewardship Council (MSC) validation and verification, as well as provides an effective platform for fisheries management and MCS purposes. The transferability and flexibility of iFIMS allows any country to take advantage of this existing technology at any time. QACs presentation highlighted the features of the iFIMS system and how it can complement a strong MCS system.

Mr. Faustino Velasco, CEO, SATLINK, S.L.

Mr. Velasco holds a degree in Economics and a Masters degree in International Trade. In 1992 he founded Satlink, where he currently acts as CEO. Mr. Velasco has maintained a longstanding relationship with the fishing world and industry, actively participating in the implementation of the VMS system (Vessel Monitoring System) in Spain, Ecuador and Panama. In recent years, he worked very closely with associations like OPAGAC as well as with other tuna fishing companies worldwide in order to keep developing the most technically advanced systems in order to improve sustainable fishing.

Since its foundation in 1992 Satlink has become the leader of the satellite communications industry. A partnership with the main satellite network operators, such as Inmarsat, Thuraya and Iridium, gave Satlink the ability to provide global coverage for voice and data services to any kind of user, regardless of its location whether at sea, on land or in aircraft. This made it possible for Satlink to address all the needs of their current customer base involved in different sectors. Satlink places a special emphasis on the fishing sector as it represents the backbone of the company in the market.

Mr. Velasco' presented the SATLINK SeaTube at the workshop with the support of Mr. Egor Zaborovsky, the Satlink technical officer stationed in Honiara to provide better support to customers in the region. The Satlink SeaTube is a system for recording and real-time monitoring that enables more control over fishing operations to fishing companies, RFMOs, and Fishery Observer Programs. The SeaTube system consists of a number of HD cameras installed onboard, a Satlink video server (NAS/NVR), and a VMS system with preconfigured EEZs. Video of fishing operations is stored onboard in the Satlink SeaTube rack and encrypted. Videos are later extracted locally from the encrypted HDD for analysis ashore by the Observer Program with a Satlink View Manager analysis tool.

Mr. Adam Batty, Project Manager, Archipelago Marine Research

Mr. Batty is a project manager for the Electronic Monitoring division at Archipelago Marine Research (AMR). Mr. Batty's background includes a Masters of Resource Management (MRM) with a focus on Fisheries Science, and more than eight years in the fisheries industry. At Archipelago, Mr. Batty specializes in designing and implementing fisheries-monitoring programs—including CCTV-based electronic monitoring applications—for many types of commercial fisheries, including large tuna purse seine, small vessel reef, and multispecies groundfish.

Archipelago Marine Research has worked with a variety of fisheries for more than 35 years, deploying human observers and providing electronic monitoring solutions. Archipelago's solution has successfully monitored a wide range of fishing applications around the world, including longline, trawl, trap, and purse seine. The presentation at this workshop reviewed Archipelago's experiences in monitoring different fisheries, and in developing and refining the main tools involved for data collection at-sea, and land-based data analysis. The presentation examined the use of EM within the compliance context, and the specific program requirements to support compliance efforts using EM. Finally, the presentation discussed the many layers that are involved in a successful EM program beyond simply the technology.

Mr. Peter A Smith, Director, Aerosonde Pty Ltd

Mr. Smith plays a major role in UAS development as a Director of Aerosonde Pty Limited, Australia's largest UAS manufacturer. He has been involved in worldwide UAS advocacy as Vice President of The Association of Unmanned Vehicle Systems Australia, and a Director of AUVSI, the Association of Unmanned Vehicle Systems International in Washington, DC. Mr. Smith co-presented with Mr. Gonella.

Aerosonde is a world leader in the design, manufacture and operation of medium UAS for civil and military operations, typically involving long duration surveillance, often covertly. Its aircraft are capable of flying for up to 20 hours, carrying high resolution EO and IR video and still cameras. Flights can be completely autonomous, using GPS and autopilot navigation. The UAS has a reputation for toughness and reliability, and is the only UAS to have successfully flown in typhoons and hurricanes.

Aerosondes have operated worldwide, specialising in missions in remote locations including many Pacific nations. Recently, Aerosonde successfully undertook fisheries surveillance trials in the Palau EEZ, demonstrating its ability to detect, identify and record video of a wide variety of large and small vessels, including details of activities on deck. In the fisheries surveillance role, the UAS is part of a larger MCS system. It can be cued by AIS, VMS and other existing data systems, and can provide video data into the wider surveillance networks.

Already able to transmit video in real time over 100 kilometres, Aerosonde is currently developing a satcom system providing unlimited range real time video, allowing even wider area search patterns. Once a target is acquired, it can be automatically followed and covertly observed to gather evidence of illegal activity or to guide a vessel to intercept. New generation software will allow automatic detection of small vessels and alert observers, reducing the need to monitor video constantly. Video can be streamed to vessels as well as to operating headquarters.

Aerosonde offers operating services for customers who do not wish to set up their own UAS operations as well as training and field service support for customers who want to operate themselves.

Mr. Maurice Gonella, BD Manager, Aerosonde Pty Ltd

Mr. Maurice Gonella is based in Australia and has worked in the unmanned aircraft industry since 1996. He is a Mechanical Engineer by trade and was involved in designing 6 variants of the Aerosonde engine. He has had many roles at Aerosonde including leading the flight operations group, production manager, and he set up the unmanned aircraft facility at NASA Wallops. During his time at Aerosonde, Maurice was involved in the first unmanned flight across the Atlantic, the first unmanned flight into a hurricane, and the 38 hour flight.

The presentation at this workshop focused on using the Aerosonde unmanned aircraft as a maritime reconnaissance tool to combat IUU in the WCPO. The Aerosonde aircraft has been in operation for many years as a maritime reconnaissance aircraft for weather missions. With the recent availability of small stabilized steerable video cameras the Aerosonde has become capable of persistent ISR (Intelligence, Surveillance, Reconnaissance) in a maritime environment. This presentation provided specific examples taken from the Palauan Aerosonde demonstration conducted in September to October 2013.

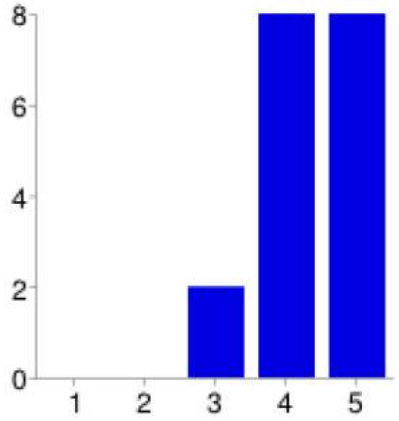
Mr. David J. Martin, VP, Global Services, exactEarth Ltd.

Mr. Martin is currently VP, Global Services at exactEarth Ltd, a data services provider which leverages advanced microsatellite technology to deliver solutions that enhance Maritime Domain Awareness. At exactEarth, Mr. Martin oversees the Global Services and Sales functions. Mr. Martin has extensive experience in the data services industry and is also an active member of the IALA and IEC AIS Technical Working Groups for the evolution of AIS standards and technical specifications.

While AIS has been in use for many years in a variety of marine applications, the technology continues to mature and evolve. The presentation at this workshop focused on the use of wide area Satellite AIS and its role in monitoring fishing activity, including recent innovations in the technology.

Appendix C: Survey Responses

On a scale of 1 to 5, how would you rank the ORGANISATION of the workshop?



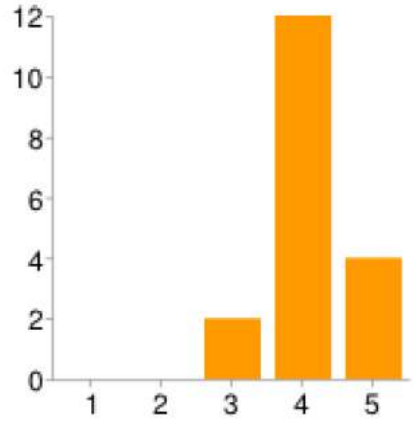
1	**0**	0%
2	**0**	0%
3	**2**	11%
4	**8**	44%
5	**8**	44%

If you answered 3 or less for the previous question, what would you recommend to improve the result of the previous question?

Better internet and telecoms access for your delegates- organise providers to come up an sell dongles/phonecards on first day

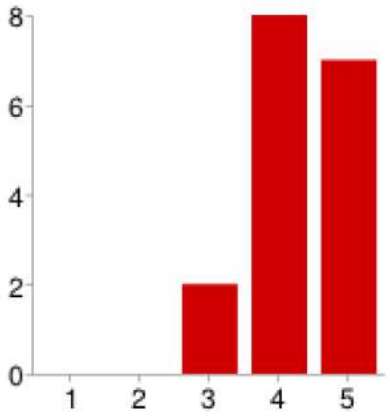
Greater awareness of workshop objectives at least month prior

On a scale of 1 to 5, how would you rank the CONTENT of the workshop?



1	**0**	0%
2	**0**	0%
3	**2**	11%
4	**12**	67%
5	**4**	22%

On a scale of 1 to 5, how would you rank the EXECUTION of the workshop?

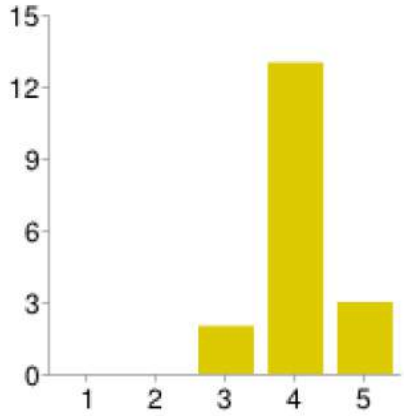


1	**0**	0%
2	**0**	0%
3	**2**	12%
4	**8**	47%
5	**7**	41%

If you answered 3 or less for the previous question, what would you recommend to improve the result of the previous question?

Perhaps content was too heavily presentation based with not enough group discussions

On a scale of 1 to 5, how would you rank the overall QUALITY of the PRESENTATIONS?

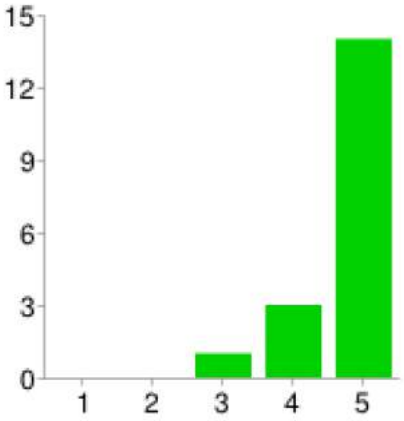


1	**0**	0%
2	**0**	0%
3	**2**	11%
4	**13**	72%
5	**3**	17%

If you answered 3 or less for the previous question, what would you recommend to improve the result of the previous question?

sometimes difficult to understand what the presenters were saying - would a written precis of the presentation offered in conjunction with the verbal delivery be of use?

On a scale of 1 to 5, how would you rank the performance of the workshop ORGANISER?

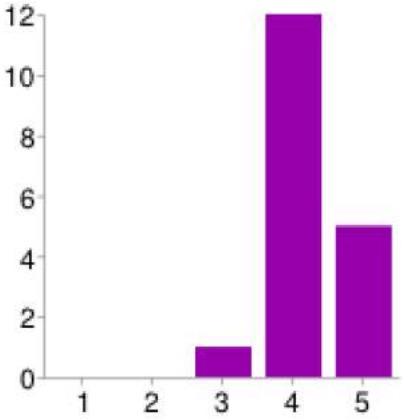


1	**0**	0%
2	**0**	0%
3	**1**	6%
4	**3**	17%
5	**14**	78%

If you answered 3 or less for the previous question, what would you recommend to improve the result of the previous question?

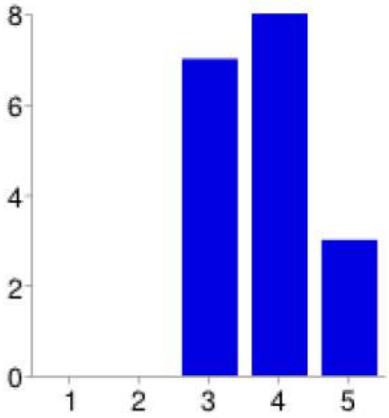
A little more publicity would have enabled more MCS officers to make arrangements for attending this workshop.

On a scale of 1 to 5, with respect to quality and utility how would you rank the workshop OVERALL?



1	**0**	0%
2	**0**	0%
3	**1**	6%
4	**12**	67%
5	**5**	28%

On a scale of 1 to 5, how would you rank the usefulness of the Day 1 Panel Discussion on the "MCS Matrix"?

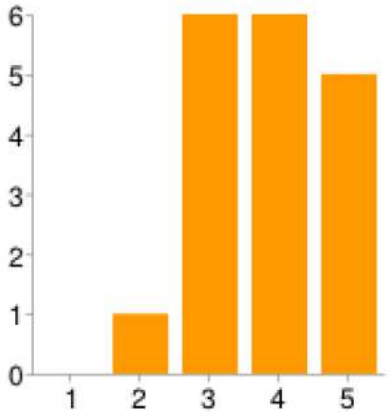


1	**0**	0%
2	**0**	0%
3	**7**	39%
4	**8**	44%
5	**3**	17%

What would you recommend to improve the Day 1 Panel Discussion on the "MCS Matrix"?

- We need to refine some of the definitions and then revise the matrix. We don't know the criteria. Overall it looks it looks really bad with lots of red, but is it really that bad or is it just a result of the scope and criteria used?
- The matrix image was hard to see on the screen.
- We needed more MCS people in the room and more linking to the FFA regional MCS strategy.
- Presentation of the matrix earlier would have provided more context for the rest of the day.
- It didn't seem to clearly feed directly into Day 2, so whilst interesting to see, the discussion regarding the matrix wasn't that interesting.
- It was not a topic that was of global interest to the attendees so it was tough to listen to the discussion.
- It would have been helpful to have a bit of clarity on the process that leads up to the development of the MCS matrix
- The discussions on the MCS matrix needs to be based on the current situation and I guess future discussions would ensure that necessary updates are done.

On a scale of 1 to 5, how would you rank the usefulness of the Day 2 Panel Discussion on "Implementation Challenges/Requirements for MCS"?

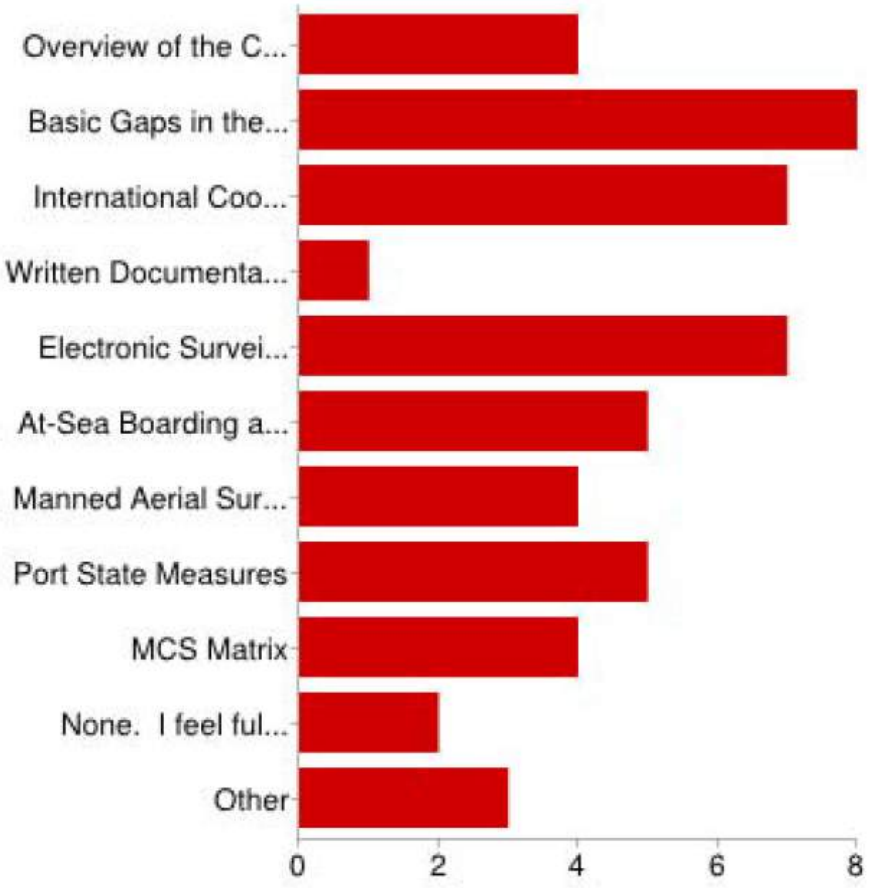


1	**0**	0%
2	**1**	6%
3	**6**	33%
4	**6**	33%
5	**5**	28%

What would you recommend to improve the Day 2 Panel Discussion on the "Implementation Challenges/Requirements for MCS"?

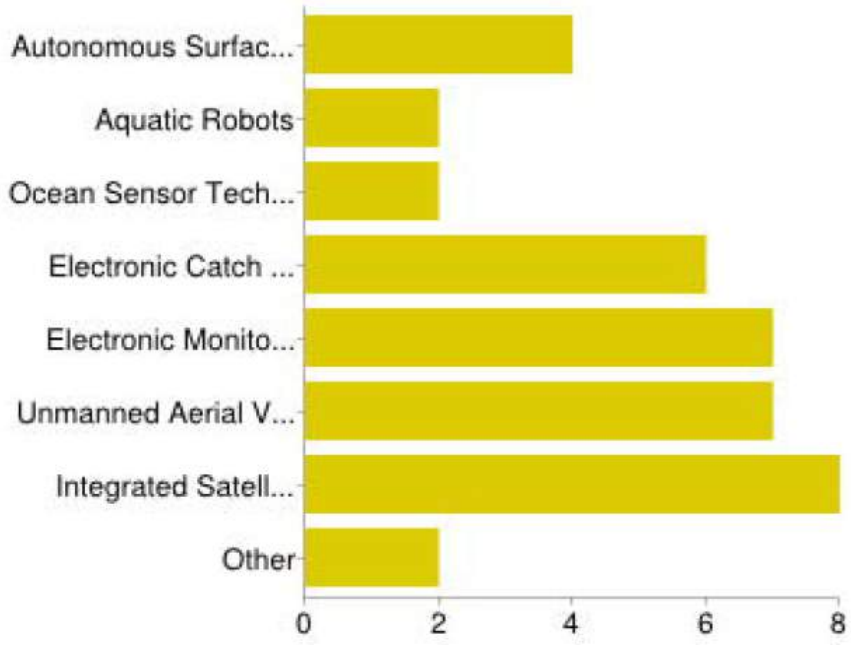
- We really needed more time and detail.
- More linkages to the current Pacific frameworks around the regional MCS strategy to unpack it....kind of seemed a lost opportunity given its up for review. but again, goes back to the participants.
- Very well moderated, but the panellists were mostly using it as a chance to do another pitch, not discuss the core of the issues.
- Technical assistance to support functioning sound system throughout workshop.
- The panel members were too interested in their own agendas so very biased.
- We needed more discussion on the cost benefit analysis on the use of technologies to supplement traditional MCS tools or to potentially replace them.
- A better understanding of the current situation in the member countries would enable us to determine what can be achieved in terms of any new MCS implementations.

What subject from Day 1 would you like to learn more about?



Overview of the Current MCS Infrastructure	**4**	8%
Basic Gaps in the MCS Framework	**8**	16%
International Cooperation	**7**	14%
Written Documentation as an MCS Tool	**1**	2%
Electronic Surveillance (VMS, eCDS, AIS, etc.)	**7**	14%
At-Sea Boarding and Inspection	**5**	10%
Manned Aerial Surveillance (overflights)	**4**	8%
Port State Measures	**5**	10%
MCS Matrix	**4**	8%
None. I feel fully informed on these issues.	**2**	4%
Other	**3**	6%

Which technology addressed on Day 2 of the workshop would you like to learn more about?



Autonomous Surface Vehicles (ASV's, i.e. Wavegliders)	**4**	11%
Aquatic Robots	**2**	5%
Ocean Sensor Technologies	**2**	5%
Electronic Catch Documentation Systems (E-logbook and E-reporting)	**6**	16%
Electronic Monitoring	**7**	18%
Unmanned Aerial Vehicles (UAVs)	**7**	18%
Integrated Satellite Imaging	**8**	21%
Other	**2**	5%

What technology that was NOT included in the workshop would you like to learn more about?

- FAD tracking buoys and associated technology (e.g. sonar)
- VMS status in the Pacific.
- Google Analytics the other such analysis software/services.
- Determining accurate Maritime Boundaries of the fishing zones of member countries.

Explain how you think one of the emerging or advancing technologies might fit into the MCS infrastructure of the FFA member states.

- Certainly having AIS incorporated as part of the licensing requirements would make sense given that it is a complementary technology to existing VMS solutions.
- Drones may be a tool to enhance Pacific patrol boat (PPB) capability. However, used alone they seem impractical.
- I think the focus on unreported data is essential for management, so catch monitoring and reporting can be used within MCS quickly and relatively easily.
- Some of the other technologies may be applicable with some better understanding of how they can help to address specific high priority issues (e.g. UAV for regional use, or AIS for small vessels).
- EM Systems could play an immediate and substantive role as the coverage for longliner vessels is very low.
- The longliners should have onboard either a human observer or an EM system.
- Vessels identified as “vessels of interest” or that receive observer related citations should be required to carry a human observer and/or an EM system.
- Video/audio capture by ASV's sent to specific target coordinates through identified satellite imaging or UAV data capture linked to VMS/AIS analysis in real-time or near real-time.
- I think the UAVs with their long time at sea, capability to carry significant payloads should in time form a significant component of the region's enforcement / surveillance program
- I believe the information gained from satellite AIS and SAR was amazing and could prove valuable to understand how some illegal fishing is conducted.
- In terms of cost affordability and technical possibilities, EM systems are most relevant to the current MCS context for FFA member countries.
- EM would be a valued asset at both the regional and national levels, but I am concerned that fragmentation in the region may make it difficult to process the EM data and ingest it in a way that would be helpful to the fisheries in the region.
- All FFA Members have access to PNA FIMS. FIMS e-Reporting can be adopted and used by FFA Member States to very quickly implement electronic Reporting from Vessels and Observers
- Using UAVs to observe activities of fishing boats could free up the observers. There is concern that the observers would then be unemployed but surely they could re-train as data analysts. There seems to be some resistance to change of methods due to cost and perceived difficulty of implementation.
- The issue of MCS seems to be regarded as ""if the rest of the world cares about this then they will pay for it"". Seems fair enough really - we need more awareness of the danger to fisheries within all governments in order to bring a change of mind about the importance of sustainable fishing. After all, everyone likes to eat tuna."
- If a technology proves to be ideal in filling in the gaps in the MCS framework, we need to get a regional agreement on the use of that technology and how it should be used. Also, we must investigate the cost of using that technology to see whether the benefits out weight the costs.
- There are opportunities for a number of emerging technologies to be integrated into existing MCS tools or frameworks and these can be applied at a regional level by for example FFA or SPC and shared among the members. Example S-AIS, UAVs, E-Reporting, E-Monitoring.

Briefly explain how you will use what you have learned in the WWF MCS Emerging Technologies Workshop.

- I have learned a great deal on MCS capabilities in the Pacific Fisheries environment plus significant amount of new knowledge on VMS was gained.
- I have gained a better understanding of how UAS might integrate with other emerging technologies
- The workshop presented a good forum to compare notes and network.
- I definitely will share this experience with media and other networks....it was fascinating. WWF should present a compressed, interactive version to high level meetings. I plan to use the WWF introductory video for some coverage as well!!!
- I made many great connections, and will be able to build on the workshop quickly in the near future. A better understanding of the current MCS practices, and bigger challenges has been extremely useful for me.
- I was able to identify capacity needs and design training delivery in focus topics aligned with regional progression with electronic surveillance
- I am looking forward to work with technology suppliers in pilot trials / R&D at the University of the South Pacific. Also, I think there are alternative applications of some technologies will be followed up for R&D undertaken by our organisation
- The information from the workshop helped me understand how UAV would fit into the MCS Matrix.
- I was pleased the workshop started at the beginning of several MCS meetings in the region. It was helpful for me to learn the history. I'm not sure I understand the direction the region would like to go but I think they are taking steps to change this.
- I will be advocating for consumers to buy fish from sustainable sources.
- I will start inquiring and investigate more on the technologies that are available and what they can do for the purpose of MCS
- With the additional knowledge learned from the workshop, I intend to make better use of these technologies with existing MCS tools and frameworks.

Please offer any additional comments regarding your perceptions of the WWF MCS Emerging Technologies Workshop.

- I thought this was an excellent workshop for industrial companies who attended. It helped to broaden our understanding of Fisheries Management and the overall IUU problem and how MCS technologies and procedures can help combat the issues.
- If invited to future workshops, we would be delighted to participate again.
- Thoroughly worthwhile.
- Useful forum, but much of what was promoted may not be relevant or cost effective to use at this time. The cost of addressing increased IUU may be exponential, whereas perception and targeted actions/technology may have more cost effective impact.
- The workshop could easily be a day longer to prompt more engaging discussions and could use a few ice-breakers to ensure participants engage more vocally earlier in the workshop as opposed to towards the end of the second day.
- I would hope that the workshop and its outcomes are shared with the wider MCS and regional fisheries community generally. Great event.
- It was great for the industry providers to meet with some of the regional actors, although the workshop's goals were a bit too ambitious, especially Goal 2, objective 4, or at least over such a short period of time. However, WWF should be commended for holding this workshop which allowed for people to make contacts.
- This was overall a very informative workshop and I was pleased we were invited.
- Thanks to WWF for providing a welcoming forum for this discussion and also a wonderful opportunity for us to meet and enjoy the company of Pacific people. It was very well organised.
- Great job!"
- The workshop provided an excellent opportunity for the vendors of the new technologies to meet up with the users and those who are in a position to implement at a regional or at national levels.
- Such meetings produce better understanding of the available technologies that can be used to meet user requirements at affordable prices."

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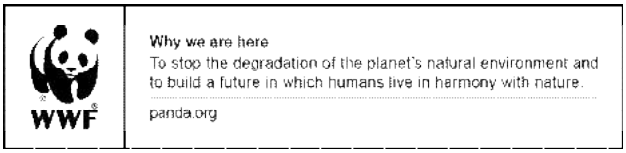
Appendix E: Abbreviations/Acronyms

AFMA	Australian Fisheries Management Authority
ASV	Autonomous Surface Vehicle
BOSS	Big Ocean Sovereignty States
CDS	Catch Documentation System
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization of the United Nations
FFA	Pacific Islands Forum Fisheries Agency
FIMS	Fisheries Information Management System
IMCS	International Monitoring, Control and Surveillance Network
INTERPOL	International Criminal Police Organization
IUU	Illegal, Unreported and Unregulated Fishing
MCS	Monitoring, Control and Surveillance
NPOA	National Plan of Action
PNG	Papua New Guinea
PICS	Pacific Island Countries
RFMO	Regional Fisheries Management Organization
RPOA	Regional Plan of Action
RSP	Regional Surveillance Picture
SIDS	Small Island Developing States
SOP	Standard Operating Procedure
UAV/S	Unmanned Aerial Vehicle/System
VDS	Vessel Days at Sea Programme
WCPFC	Western and Central Pacific Fisheries Commission

Our Smart Fishing Vision and Goals:

Vision: The world's oceans are healthy, well-managed and full of life, providing valuable resources for the welfare of humanity.

2020 Goals: The responsible management and trade of four key fishery populations results in recovering and resilient marine eco-systems, improved livelihoods for coastal communities and strengthened food security for the Planet



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