Fisheries Newsletter

NUMBER: 132 (May–August 2010) ISSN: 0248-076X

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Editorial

SPC's *Fisheries Newsletter* is almost 30 years old. It was first published in April 1971 under the name of *South Pacific Islands Newsletter*. Since then, the newsletter has undergone several changes in format. We recently felt that it was once again time for a subtle facelift. SPC's Layout Artist, Carla Appel, has developed the new layout format of this issue. I hope you will appreciate the elegant changes she made.

In the editorial of issue #1, the author stated that he hoped the newsletter would provide "a review of the initiation and progress of action programmes in all fields of fisheries relevant to the reefs and lagoons, their conservation and exploitation". If we add oceanic waters, our goals are comparable. We still find it important to report on the activities of SPC fisheries programmes, particularly on expected or achieved results. In the world of development, positive results are often a long time in coming; several articles in this issue show that dedicated people continue to work hard to make these changes happen.

Shark populations are reported to be dwindling in most of the world's oceans, but data to evaluate their status in the western and central Pacific are very scarce. Shelley Clarke reports on a three-year research plan that will evaluate the status of eight key shark species. She explains why this plan will be "a major step toward addressing concerns about shark populations" in our region. We close the issue with an article by Geoff McPherson and Tom Nishida on toothed whale depredation mitigation. As you will find out, making noise underwater is a promising avenue that is being explored by very inventive researchers.

Aymeric Desurmont
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The oceanic whitetip shark is a species that will be studied under the research plan recently approved by WCPFC. Image: Mark Atwell - www.damphotos.com.

Secretariat of the Pacific Community

Prepared by the Information Unit, Division of Fisheries, Aquaculture and Marine Ecosystems

EU-funded SciCOFish project gets underway

Background

Fisheries resources of Pacific ACP[1] countries are the target of efforts to improve the lives of Pacific Islanders. Oceanic resources provide around one-quarter of the world's tuna catch; support both small- and large-scale fishing enterprises; provide government revenue; and, in many countries, represent the main opportunity for economic development. Coastal fisheries contribute to food security and the livelihoods of hundreds of thousands of people across the region. Both oceanic and coastal resources are at risk of overfishing, however. In oceanic fisheries, a rapid growth in industrial fishing effort threatens two important commercial tuna species. In coastal fisheries, food fish resources are overexploited in the vicinities of major population centres, while certain invertebrate species that are harvested for export are severely depleted across much of the region. Well-informed management action is needed to halt and reverse these trends.

The Regional Strategy Paper (RSP) and Regional Indicative Programme (RIP) agreed on by Pacific ACP countries and the European Community (EC) for the period 2008–2013, identifies "sustainable management of natural resources" as one of two focal areas for the 10th European Development Fund (EDF10) cooperation. The intervention framework for this focal area consists of assisting the region in developing the economic potential of its natural resources in a sustainable way through sound science upon which management decisions can be made.

The Scientific Support for the Management of Coastal and Oceanic Fisheries in the Pacific Islands Region (SciCOFish) project will complement the ongoing EDF-funded SciFish Project[2], while following on and learning from the PROCFish[3] and CoFish[4] projects, both of which focused on tuna and reef fishery assessment and monitoring. The SciCOFish project will fulfill the visions of the RSP and RIP for Pacific ACP/EC cooperation in fisheries, and will broaden the growing cooperation between Pacific ACP countries and the EC in fisheries.

Overall objective

SciCOFish's overall objective is the conservation and sustainable use of coastal and oceanic fisheries resources in the Pacific ACP region. The project addresses a key aspect of the RIP: the development of cost-effective solutions for sustainably managing marine and land-based resources. The project directly responds to Pacific ACP leaders' Vava'u Declaration and the recent 2008 Forum Leaders' meeting in Niue, which called for comprehensive fisheries conservation measures, both in exclusive economic zones and on the high seas; and the sustainable and effective management of national coastal fisheries.

Purpose

The purpose of the SciCOFish project is to provide a reliable and improved scientific basis for management and decision-making in oceanic and coastal fisheries. The project will provide Pacific ACP countries with 1) the means to develop efficient management measures; 2) the skills to monitor their effectiveness; and 3) some important tools to combat illegal, unreported and unregulated (IUU) fishing on the high seas. A "demand-driven" approach to implementation will ensure that assistance is provided to those countries that are most likely to take up management advice.

Project results

Project results will be in two main areas: scientific support for oceanic fisheries management (component 1) and scientific monitoring and management of coastal fisheries (component 2). These two components will strengthen scientific understanding of oceanic and coastal ecosystems, and will help address cross-cutting issues such as ecosystem relationships and the impacts of climate change by linking results via databases. Oceanic activities will provide scientific support for new tuna management initiatives adopted by Pacific ACP countries at a critical time for the conservation of stocks. In particular, intensive observer training and the enhancement of national fishing activity databases will, in combination with the development of a monitoring, control and surveillance strategy under the proposed DevFish2[5] study, allow more effective identification and deterrence of IUU fishing activities. Furthermore, the proposed modelling studies respond to calls by Pacific ACP countries to develop tools and strategies for evaluating national impacts from management measures

[1] ACP = African, Caribean and Pacific countries (Cook Islands, Fiji, Kiribati, Federated States of Micronesia, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu).

[2] SciFish = Scientific Support for Oceanic Fisheries Management in the Western and Central Pacific Ocean Project

[3] PROCFish = Pacific Regional Oceanic and Coastal Fisheries project. PROCFish was funded by the European Development Fund and implemented by the Secretariat of the Pacific Community. This five-year project was initiated in March 2002.

[4] COFish = Coastal Fisheries project.

[5] DevFish = Development of Tuna Fisheries in the Pacific ACP Countries Project

and alleviating the effects of climate change. Coastal activities will focus on (through initial stakeholder consultations) projects that combine an urgent resource management issue with a strong local capability to address the issue and maintain a long-term programme.

Component 1: Pacific ACP governments, the Pacific Islands Forum Fisheries Agency, and the Western and Central Pacific Fisheries Commission will be provided with scientific data, modelling, and advice on oceanic fisheries in order to underpin their management decision-making and strategic positioning.

Project activities include:

- developing observer training and systems;
- developing integrated tuna fisheries databases;
- modelling bioeconomic parameters and providing national advice;
- ecosystem modelling of management and climate change; and
- validating key model parameters through tagging.

Component 2: Pacific ACP governments, the private sector and communities will be provided with technical methods and training to monitor coastal fisheries, which will result in practical scientific advice for informing management decisions, and the development of in-country capacity to evaluate the effectiveness of these decisions.

Project activities include:

- conducting stakeholder consultations;
- developing local capacity to implement field monitoring protocols;
- developing and implementing secondary data collection protocols; and
- developing management advice.

Staff

Most staff positions have been filled although several additional positions will be recruited in 2011 under Component 1. Staff members working for the SciCOFish project are:

Project Administration and Communications Officer: Anne Lefeuvre

Anne is an agroeconomist who specialises in natural resources management. She has been working on international projects in various technical areas. Before joining SPC, she was a technical assistant for activities planning and assessment for a regional EDF programme on protected areas management in Central Africa. She is French and has worked in the Pacific Islands region as well as in Africa and Latin America. Her fisheries experience has focused on the preservation of marine biodiversity and on the economic development of the fisheries sector.

Fisheries Scientist (National Support) for Component 1: Ashley Williams

Ashley joined the Stock Assessment and Modelling team in mid-September 2010. He came from the Ecosystem Monitoring and Analysis Section of SPC's Oceanic Fisheries Programme where he was principally responsible for analysing biological and ecological data leading to the enhanced understanding of population dynamics of South Pacific albacore tuna. Prior to this appointment he was a Senior Research Fellow at the Fishing and Fisheries Research Centre at James Cook University in Townsville, Australia where he led several research projects that focused on providing fisheries managers and stakeholders with pertinent information for assessing and managing fisheries within the Great Barrier Reef World Heritage Area and Torres Strait. His PhD research at James Cook University examined the implications for fisheries management of spatial and temporal variation in life history parameters of a commercially important coral reef fish.

Data Audit Officer for Component 1: Bruno Deprez

Bruno is an engineer with a Master's degree in IT, who has worked in different professional settings — from developing pharmaceutical software in the USA to setting up a new statistical information system for use with socio-economic and stock evaluation surveys for the Seychelles Fishing Authority.

Sub-regional Observer Trainer (Pohnpei) for Component 1: Manasseh Avicks

Manasseh is from the Solomon Islands but joins us from the Marshall Islands, where he coordinated the port sampling and observer programmes for the Marshall Islands Marine Resources Authority. He has been contracted by SPC and the Pacific Islands Forum Fisheries Agency in the past, and is well known to observer coordinators in the region through his participation at Observer Coordinators Workshops. Manasseh has a great deal of experience managing tuna fishery sampling programmes and training samplers, and will work from Pohnpei to improve the sampling programmes in the northern part of the region.

Reef Fisheries Information Manager for Component 2: Franck Magron

Many readers will remember that Franck held the same position within the PROCFish/C project, where he developed the regional coastal fisheries database and supporting query systems. Franck has worked in many SPC member countries through his previous post, assisting with database development. More recently, he has been coordinating a "monitoring the vulnerability and adaptation of coastal fisheries to climate change" project, and developing a database and photo-quad analysis tool for coral reef monitoring.

Fisheries Scientist (finfish) for Component 2: Being Yeeting

Being has worked as SPC's Fisheries Scientist (live reef fish trade) for the last nine years, and has worked in most of SPC's member countries, assisting with surveying, data analysis, development and management of aquarium fish fisheries, as well as some work on live reef food fish fisheries. A large part of Being's work has focused on training and capacity building of local fisheries staff. Being also has experience in monitoring spawning aggregations of reef fish, underwater visual census methodologies, and sampling and monitoring protocols for ciguatera-related toxic algae.

Fisheries Scientist (invertebrates) for Component 2: Kalo Pakoa

Like Franck, Kalo previously worked for the PROCFish/C project as a Reef Fisheries Officer, where he conducted invertebrate surveys and data analysis in many SPC member countries, while training some country staff in invertebrate survey methodologies. He was also involved in several targeted invertebrate surveys designed to answer specific management needs for key commercial species. Kalo's experience in Vanuatu included invertebrate survey work for management purposes, and coordinating a project on "enhancing coastal and marine ecosystems resilience to climate change impacts through strengthened coastal governance and conservation measures".

Project Administrator and Support (half-time position) for Component 2: Marie-Therese Bui

Marie-Therese was the Project Administrator with the EU-funded PROCFish/C project and has worked for SPC for many years. She fully understands the EU finance and reporting systems as well as those for SPC. She will be working half-time with the SciCOFish project (Component 2) and half time with other areas of SPC's Coastal Fisheries Science and Management Section.

Work plan for 2010

The contribution agreement between SPC and the EC was signed in April 2010 and project activities began in July.

The project's oceanic component will focus on observer trainings provided in several North Pacific ACP countries (i.e. Federated States of Micronesia, Kiribati, Marshall Islands and Palau), while procedures will be developed and documented for national tuna data audits and auditing systems for national port sampling. The development of SEAPODYM software for providing national-level analyses will be undertaken, and a two-month tuna tagging cruise focusing on bigeye tuna in the central Pacific will be made.

The project's coastal component will identify the types of monitoring assistance that is needed to address countries' specific management needs, and will begin fieldwork when requests are received or identified for specific monitoring or assessment work necessary for making management decisions. In support of this, the development of database modules for specific monitoring approaches that are identified will begin and at least one national or sub-regional workshop covering monitoring protocols or data collection and analysis is planned.

A regional workshop is also being organised on "Approaches to implementing and monitoring community-based ecosystem approach to fisheries management (CEAFM): Finding common ground between coastal fisheries and conservation approaches in the Pacific". The workshop will be held in Noumea, New Caledonia from 29 November to 3 December 2010, and will bring together key stakeholders from national government conservation and fisheries departments, regional and national non-governmental organisations, and other institutions working in the CEAFM area (including monitoring) to try to find common ground between fisheries and conservation approaches in the Pacific. Collaborations will also be explored so that there is better service delivery at the community level, with consistent messages being delivered, and complementary systems put in place for both management and monitoring purposes, taking into consideration possible climate change effects and the need for adaptation.

Some activities are shared by both components of the project:

- East Timor is not an SPC member but is an ACP country, and therefore must be included in SciCOFish activities. An initial SPC visit will be undertaken in late 2010 to meet national partners of this country and to identify opportunities for project engagement.
- A gender analysis study is planned for late 2010. The project's gender objective is to increase women's benefits from fisheries by increasing their participation in different areas of oceanic and coastal fisheries science and management. To measure this increase in participation, it is necessary to establish a bench mark of the current situation so that increases can be detected at the end of the project. Three countries have been chosen for the gender analysis: Solomon Islands (Melanesia), Marshall Islands (Micronesia) and Tonga (Polynesia).

  An invitation for proposals by consultants was advertised in August. The consultant(s) will undertake this analysis with a focus on 1) collecting and analysing sex disaggregated data in different areas of involvement; 2) identifying and assessing national factors that form barriers to women's participation in fisheries science and management; 3) identifying specific approaches and measures to address barriers that have been identified; 4) identifying opportunities for specific interventions in each of the three countries; and 5) developing a gender mainstreaming toolkit for increasing women's participation in fisheries science and management with gender indicators.

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This issue of SPC's Fisheries Newsletter *was produced with the financial support of the European Union.*

The views expressed in this publication do not necessarily reflect the views of the European Commission.

Sport fishing training workshop in Aitutaki, Cook Islands

"This was the first time in my entire life that I caught and released a fish alive, and the feeling was magnificent!" This is how trainee Dawn Marsters, an experienced Aitutaki fisherman aged 39, described his first experience with "catch-and-release" fishing at the closing ceremony of the first workshop ever organised by SPC for prospective sport fishing guides. This genuine comment alone was proof that the training had been successful in changing participants' relationship with their lagoon, and raised hope that some may, in the near future, derive benefits from this new, non-destructive, and tourism-based fishing activity.

A feasibility study conducted in May 2009[1] concluded that sport fishing could be diversified in Rarotonga (a couple of operators doing jigging or casting techniques to complement a sustainable FAD-based big game activity) while a more extensive development could possibly occur in Aitutaki (flyfishing for bonefish, casting or jigging for large costal predators, light casting inside the lagoon). After training two key stakeholders — Richard Story, Ministry of Marine Resources (MMR), Aitutaki; and Pupuke Robati Junior, small-scale sport fishing operator, Rarotonga — and after conducting a feasibility for the tourism-based bonefish fishery in Aitutaki,[2] SPC further supported the local development of coastal sport fishing through a specialist training workshop for several prospective guides selected by MMR (13–23 June). This training and the purchase of quality sport fishing gear and tackle were part of the action plan developed in May 2009. MMR purchased and will monitor the fishing gear while SPC conducted the training workshop. This workshop was one component of a comprehensive training programme that combined first aid, small business management, hospitality and tourism, and a boat driver's certificate course, with local training institutions involved and trainers flying to Aitutaki for the occasion.

All seven trainees were either small-scale fishermen or budding guides from Aitutaki. Resource people included Richard Story (manager of the Aitutaki Marine Research Centre – AMRC), Nga Makikiriti (course coordinator, MMR– Rarotonga), Pupuke Robati Junior (small-scale fisherman and sport fishing operator, Rarotonga), Etienne Picquel and Michel Blanc (Nearshore Fisheries Development Adviser, SPC). The first two days of the workshop were held in town at the Island Council meeting room. This was followed by four days of sport fishing practice with the last fishing trip (Tuesday, 22 June) conducted as a simulation exercise (i.e. with trainees acting as fishing guides and trainers as the tourists).

At the end of the workshop, a number of suggestions were made by the visiting team to help MMR further

All fish caught during the workshop were carefully released alive.

[1] Picquel E. and Blanc M. 2009. Feasibilty study on the development of sport fishing in Cook Islands. Secretariat of the Pacific Community.

[2] Hamon H. and Blanc M. 2009. Report on a bonefish fishing feasibility study on Aitutaki, Cook Islands. Secretariat of the Pacific Community.

Casting inside the lagoon with light and medium tackle produced good results. Workshop participant Etetia Davey in action on day 1 of the workshop.

*A nice brassy trevally (*Caranx papuensis*) proudly displayed by Nga Makikiriti (MMR-Rarotonga).*

support the development of tourism-based sport fishing operations on Aitutaki. Some of the issues discussed below may be of interest to other Pacific Islands wishing to take the same development path.

Future training

- The workshop went very well, due to good coordination by MMR staff and their selection of enthusiastic trainees. The consultant trainer has emphasised key aspects of professional guiding, including the safety and cleanliness of boats, professionalism of guides, care of customers, and the maintenance of fishing gear and tackle. The workshop's format was suitable but another day or two of actual fishing would have enabled trainees to practice more boat driving and guiding skills. On-shore training (gear description, rigging, knots) also should have been extended by an extra half day. The other training components were completed before and after the sport fishing workshop (e.g. business management, tourism and hospitality, first aid). A boat master's course will be conducted soon on Aitutaki. and this will conclude this training programme and the process of certification and/or licensing of guides.[3]

One type of boat used on the island for a day of casting and jigging outside the lagoon.

The sport fishing context

- Aitutaki has the potential to be a multi-fishery destination (e.g. flyfishing for bonefish, blue fishing at FADs, reef and lagoon fishing). Flyfishing is already available to expert anglers, with a couple of excellent local guides ready to host visitors in a professional manner. Their "flat boat", which is suitable for fly-fishing, only requires some slight upgrading. Casting or jigging appears to be seasonal for giant trevally and dogtooth tuna, and year-round for tunas at the FADs. Very good ultra-light and medium-light casting for small trevallies can be found inside the lagoon. At present, there is room for two or three local guides but they were not yet ready at the time of the workshop (lack of suitable fishing gear and boats).
- Manue Atoll is potentially a prime destination for giant trevally "popping" and bonefish flyfishing. The promotion of sport fishing trips to Manue should, however, be approached cautiously because of the distance of the atoll from Aitutaki (50 nm), and the current lack of suitable vessels to undertake safe and comfortable charters. An exploratory trip with a reputable sport fishing tour operator is worth considering.
- Currently, Rarotonga appears to be more easily "marketable" overseas than Aitutaki. There is at least one sport fishing guide who can handle two customers on his potimarara and provide FAD fishing, trolling, reef casting and jigging. Because fishing areas are within seconds of Avatiu Harbour and because the island is so small, six-hour day trips or half-day trips are preferable to the eight-hour-long trips that are usually expected of tour operators. Other big game fishing boats operating in Rarotonga bring additional options for the marketing of Rarotonga as a sport fishing destination.

[3] Under the bonefish management plan, in order to be certified as a fishing guide, a person needs to sit the first aid, hospitality and boat master's training modules.

The resource

- The management and conservation needs with regard to developing sport fishing in Aitutaki are wide-ranging. While the draft bonefish management plan deals specifically with managing the bonefish fishery, it is important to also address the issue of lagoon use in order to avoid conflicts between the different users of the island's reef flats and motus (e.g. lagoon cruises, kite-surfing, flyfishing). Some guidelines, and possibly a management plan for lagoon use, should be developed in consultation with different users, either as part of the Bonefish management plan or under a separate document.
- From the workshop, we learned that trevallies require some management attention as well. Four species are common in Aitutaki's lagoon: giant trevally (*Caranx ignobilis*), brassy trevally (*Caranx papuensis*), island trevally (*Carangoides orthogrammus*) and bluefin trevally (*Caranx melampygus*). The two motus that we have prospected (central-southern part of the lagoon) are ideal places for targeting those species as well as bonefish. We suggest that fishing around these motus be only permitted for professional fishing guides with customers. Fishing gear and fishing effort should be controlled in order to ensure the sustainability of the resource and the sport fishing activity in those areas. For instance, fishing at those motus could be limited to two groups of customers weekly. Treble hooks should be banned there and only lures with one barbless single hook allowed. Small trevallies are still found in good numbers around Aitutaki. They can be fished inside the lagoon from a boat (casting towards reefs and "bommies") or by wading. They fight well on light gear and will please many customers.
- Casting or jigging outside the reef was not productive during the workshop because weather conditions made fishing difficult. Locals, however, say that the season for catching giant trevallies is when the baitfish go inside the lagoon (November to January). Casting for giant trevallies could be marketed for that period.

The guides

- Two of the trainees (Dorn Marsters and Junior Palampera) are experts in the art of tuna handlining at FADs. If they fish the FADs using a "buddy system", clean and upgrade their boats, and acquire a couple of sets of jigging rods and tackle, they will be in a position to take tourists out, have them jig for albacore and yellowfin tunas, and have them watch or practice local fishing methods (e.g. drop-stone fishing).
- Itu Davey and his brother Etetia are likely to succeed in their bonefish guiding activity, having displayed excellent guiding skills at the workshop. Since our previous visit in November 2009, Itu has successfully guided several customers. A video documentary produced by "On the Fly Productions" will also undoubtedly raise the interest of expert anglers to come to Aitutaki to catch some "trophy" bonefish. Itu is currently negotiating a bank loan to buy an engine and upgrade his boat.
- During the workshop, the need for cohesion and teamwork was stressed and the idea of a sport fishing association was raised. One of the trainees, Punua Marsters, was particularly interested in the idea of an association, and he could play a leading role in promoting it. The SPC-based DevFish-2 project is in a position

Junior, a skilled tuna fisherman, enjoyed learning the tricks of sport fishing with light gear.

to support the establishment of such an association. For instance, an executive officer could be recruited to undertake the much-needed liaison role between individual customers (or overseas tour operators) and local guides and accommodation owners.

- One key prerequisite for successful sport fishing ventures is professionalism. In that respect, most workshop participants fell far below the standards expected by tour operators in Australia, Europe and the USA. Weaknesses included lack of vessel cleanliness, sea safety equipment and guiding skills. Training has obviously focused on those areas, and many tips and advice have been given. The progress of prospective guides needs to be monitored, and we suggest that a follow-up visit by the consultant trainer be organised in about six months' time (early 2011). The purpose of this visit would be to go fishing with the local guides to evaluate their guiding skills and give them further advice and training.
- The trainees enjoyed the workshop and seem comfortable with the concepts and ideas introduced during the training. If they want to establish themselves as fishing guides, they will, however, need to change their current way of working and upgrade their assets (i.e. boat, safety gear, fishing gear). A national scheme exists to support outer islands development and grants are possible. Some fishermen, like Itu, may prefer to take a short cut and seek a bank loan.

SPC and MMR involvement

- SPC has completed its commitment to support coastal sport fishing development in Cook Islands. With complementary funding assistance from Taiwan/ROC, two feasibility studies have been carried out (bonefish fishing on Aitutaki, casting/jigging on Rarotonga and Aitutaki), the bonefish management plan has been drafted, two training attachments have been funded (Pupuke Robati Junior and Richard Story spent some time with a New Caledonian sport fishing operator in 2009), assistance was provided to MMR for procuring demonstration fishing gear and tackle, and this workshop has been implemented. The suggested evaluation of the Aitutaki guides in 2011 could be SPC's final input into this project.
- MMR will fine-tune and implement the bonefish management plan, and will contribute, with the police, to its enforcement. MMR should also maintain the momentum by conducting regular sport fishing trips with two or three trainees at a time. This will put to good use the fishing gear and tackle recently purchased by MMR.

*Richard Story (MMR) with a good-size brassy trevally (*Caranx papuensis*).*

Conclusion

Aitutaki has very good potential for developing a tourism-oriented sport fishing sector. While bonefish flyfishing has a great potential and appears ready to be marketed, some work remains to be done with other fishing activities (e.g. jigging and casting techniques). The strict conservation measures currently taken to enhance the bonefish stock are a good step forward; however, lagoon use and other key sport fish species require a similar attention.

The trainees who attended this workshop seemed enthusiastic about being part of this sport fishing development. While their knowledge of Aitutaki's marine resources give them a solid base, they need to adopt and put into practice the concepts demonstrated at the workshop if they are to succeed as commercial fishing guides. MMR has an important role to play by managing the resource (e.g. developing a bonefish management plan) and supporting the local guides as they set up their sport fishing operation (e.g. by providing advice on financial support schemes, training and monitoring).

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Are moored fish aggregation devices the solution to sustaining small-scale fishing?

Moored fish aggregation devices (FADs) are once again at the forefront of Pacific Island government fisheries departments' list of priorities when addressing food security and safety-at-sea issues. Between March and June of this year, SPC's Nearshore Fisheries Development Section (NFDS) constructed 42 FADs and deployed 21 of these in three Pacific Island countries: 33 nearshore FADs were constructed for Kiribati, with 1 FAD each deployed off 11 islands in the group. The other 22 FADs were stored away for future deployment at other sites. Six offshore FADs were constructed and deployed at six sites in Samoa and three offshore FADs were constructed and deployed at three sites off Majuro in the Marshall Islands. Future FAD projects are in the pipeline for several other Pacific Island countries.

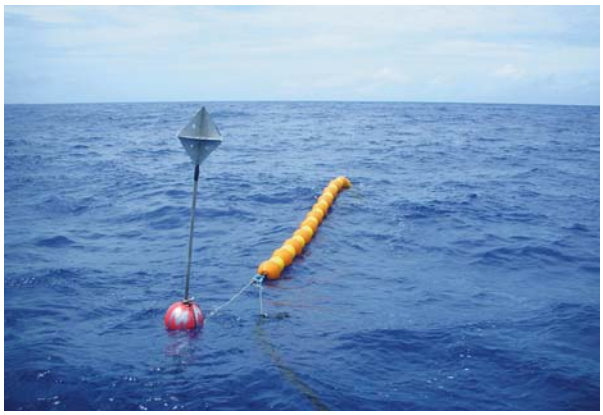
Constructing nearshore FADs in Tarawa, Kiribati.

So, why are moored FADs in demand again by Pacific Island coastal fishermen? The truth is, the need for moored FADs never really dissipated. Since the start of SPC's various FAD projects (mid-1980s), small-scale Pacific Island fishermen have continued to appreciate the concepts and practical application of moored FADs to their fishing operations. Moored FADs enhance the chances of catching fish and provide a central location to carry out fishing operations. Fishermen do not have to scout vast ranges to fish running schools, which reduces a fisherman's operating costs. This factor alone should be sufficient to attract fishermen to moored FADs, especially considering the current high fuel prices throughout the Pacific region. There is also the safety factor where, in case of engine problems, there is a good chance that other boats will be around to provide assistance or, in cases where boats do not return to base at the expected time, their route can be back-tracked from the fisherman's base to the moored FAD site or vice-versa. In addition, moored FADs complement inshore marine protected areas (MPAs) by providing an alternative location for fishermen to catch fish while giving reef stocks time to recover.

Funding woes

Few stakeholders have recurring funds to maintain ongoing FAD programmes. In most cases, FADs are deployed when or if funds are made available, so FAD deployments are intermittent, with hardly any maintenance or backup plans. In the last two to three years, many Pacific Island fisheries departments had a lapse in their FAD programmes because they had to prepare well in advance to secure funding. Quotations for FAD materials and logistical costs of FAD programmes had to be identified well in advance for approval before being incorporated into the budget for the next fiscal year. This is why this year many Pacific Island countries have asked to revive their FAD programmes. SPC's Nearshore Fisheries Development Section has assisted these islands with identifying material requirements and sourcing quotations from suppliers.

Nearshore FAD moored off Banaba Island, Kiribati.



Offshore Indian Ocean FAD moored 3 nm off Ajaltake in Majuro, Marshall Islands.

There are probably two main reasons why stakeholders found it hard to secure funding. One reason is that many FADs did not last as long as it was hoped, so the long-term potentials of FADs could not be sufficiently ascertained to convince budget controllers and donors that FADs were handy implements for fishermen. The short lifespan of previous FADs was mainly due to poor weather-resistant designs; too many joining parts in the mooring system that became weak points; lack of funding to maintain a consistent FAD programme; and vandalism.

The other reason is because stakeholders did not produce sufficient data to highlight the effectiveness of FADs in terms of catch rates and food security impact. In many cases, during budget bashing, parliamentarians questioned the need to throw away money on devices that did not last long enough to justify the cost of putting them there in the first place. Bilateral grant assistance agencies and non-governmental organisations also had the same reservations. Very few Pacific Island government fisheries departments or fishing associations maintained logbooks on FAD activities, which they could have used to emphasise the benefits of FADs to local fishing communities.

Data collection on FAD activities

Considerable work is now being carried out by SPC's Nearshore Fisheries Development Section in collaboration with Pacific Island fisheries departments to highlight the importance of FAD data collection. Data collection has been made a priority of FAD programmes. Pacific Island government fisheries staff will coach fishermen on how to complete the logbooks. They will also provide information and explain how fishermen's input will help to obtain funds and manage FAD fisheries activities. Ideas are being tried out to simplify logbook entries in order to make it more user-friendly for fishermen yet still provide sufficient information for fisheries management controls.

Another look at FAD designs

Ever since FADs were identified as being advantageous for small-scale offshore fisheries development in the region, SPC has been tasked with providing insights and technical information on FAD development work. The challenge was to produce durable and affordable FAD designs that could withstand the worst of the tropical

Briefing Marshall Islands Marine Resource Authority staff on FAD work and the importance of data collection.

Pacific Ocean's sea conditions for up to three to five years. If it were possible, fishermen who spend a lot of time at sea would like FADs to remain in the water forever. The problem is that the more durable the design, the more expensive it is to produce and Pacific Island stakeholders cannot afford to install costly designs.

A concerted effort was made in identifying cost-effective and durable FAD designs that were suitable for the region. Several FAD manuals and training materials were produced to provide technical details on site surveys, construction, deployment and maintenance. The two designs recommended for regional adoption were the SPC Spar Buoy and the SPC Indian Ocean type FADs. These FADs were reasonably priced and could last for many years if constructed and maintained according to specifications. The Indian Ocean FAD is becoming the more favoured of the two designs because it is easier and cheaper to construct. Anyone with basic rope-work skills can put the Indian Ocean FAD together. The recently revised Indian Ocean FAD is a very good offshore FAD that can last three to five years (or more). The Spar Buoy FAD, on the other hand, requires an experienced boilermaker to fabricate and weld the plates together. The Spar Buoy also exerts greater tension on the mooring and requires more maintenance attention than the Indian Ocean FAD.

Despite efforts already made in producing durable and affordable FAD designs, new developments continue to surface with changes in priorities and parameters. Previously, it was advised that FADs aggregate most effectively when moored 4–5 nm from seaward reefs and spaced 10–12 nm apart. When applied to industrial-scale commercial fishing, especially purse-seine and pole-and-line fishing, this may hold true because bigger vessels need upwards of 20 t of fish per FAD to make it worth their while to fish there. They will also need clear space around FADs to conduct their fishing operations safely. However, for small-scale commercial fishing, 10–20 t should suffice, although when fully functional, FADs can aggregate upwards of 100 t of fish whether they are nearshore or offshore FADs. The precept that nearshore FADs would not be productive is not entirely true. Nearshore FADs can be just as effective for small-scale fishermen as offshore FADs are for industrial fishing. The same principle applies; it depends on the target species and the location in which they are moored.

Nearshore FADs

Increases in fuel costs, small-craft sea safety issues, and increasing requests by canoe and non-powered craft fishermen to be considered as part of fisheries development plans has prompted several Pacific Islands fisheries departments to re-examine their FAD programmes to include nearshore FADs as well as offshore FADs. Because most non-powered craft fishermen live in rural areas or outer islands, it was decided to design a FAD that is not only durable and affordable but also easily constructed and deployed in rural and outer island settings using light-gauge material and a smaller anchor system so that the whole unit could be transported and deployed using the type of boats available in the outer islands.

While the SPC Indian Ocean FAD is still the preferred design, outer island fishermen are not able to readily deploy these types because the anchor system is too heavy and bulky and they don't have heavy lift equipment or big vessels for deploying them. Fishermen would need to wait for a trading vessel to arrive and this would be too restrictive and expensive for rural and outer island fishing associations to maintain sustainable FAD programmes.

Purchasing FAD gear, and constructing, deploying and maintaining FADs can easily be done by island fishermen. It is possible for island fishing associations to have direct input into running their own FAD programmes if FADs are modified so that they can be deployed from 5-m to 7-m outboard powered boats, which are common in the islands. This is one of the areas that SPC's Nearshore Fisheries Development Section is trying to address by trying out several nearshore FAD designs. So far, good headway is being made and several critical areas have been identified for improvement. More time is needed to assess the durability of designs and the results will be published when information becomes available.

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Sixth Scientific Committee meeting of the Western and Central Pacific Fisheries Commission

One of the most important meetings for SPC's Oceanic Fisheries Programme (OFP) and SPC member countries and territories is the yearly Scientific Committee (SC) meeting of the Western and Central Pacific Fisheries Commission (WCPFC). The SC reviews the current state of scientific knowledge, and sends recommendations and advice to WCPFC, which manages the world's largest and most valuable tuna fishery. In its role as the science provider to WCPFC, OFP provides stock assessments, fishery statistics and other scientific work. Before and during each meeting of the SC, OFP also gives scientific support to SPC member countries and territories.

This year, the sixth meeting of the SC was held in Nuku'alofa, Tonga, from 10–19 August. OFP provided the majority of the scientific research with over 30 papers, including a review of fisheries; stock assessments for bigeye and skipjack tuna; an evaluation of current management measures; and a review of progress in the regional tuna-tagging project. A brief summary of these presentations is presented here.

Fisheries review

In 2009, the tuna catch in the western and central Pacific was the highest ever recorded, at 2.4 million tonnes (t), which represents 58% of the global tuna catch. This was primarily driven by the record skipjack catch of 1.8 million t, which is nearly 120,000 t higher than the previous record. The albacore catch was the second highest on record, with very good catches from the longline fishery. The largest part of the catch was skipjack caught by the purse-seine fishery (Fig. 1). The review also indicated that despite the various restrictions imposed on the purse-seine fishery in 2009, including the two-month FAD closure, both total and FAD-related purse-seine effort has been increasing in recent years.

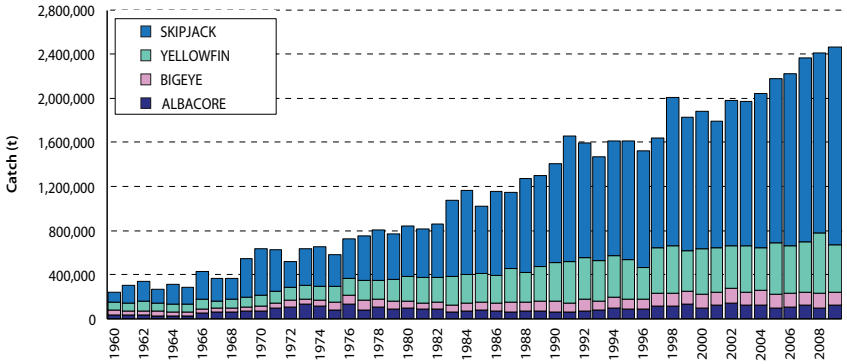

Figure 1. Catch (t) of albacore, bigeye, skipjack and yellowfin in the western and central Pacific Ocean.

Stock assessments and management advice

The 2010 bigeye tuna assessment, presented by Dr Shelton Harley (head of the SPC's Stock Assessment and Modelling Section), indicated that overfishing was occurring, and that the stock was either slightly overfished or soon would be. Overall, the 2010 assessment was marginally more optimistic than the 2009 assessment, but the SC still recommended to the Commission a 29% reduction in fishing mortality from recent levels.

OFP's Senior Fisheries Scientist, Dr Simon Hoyle, presented results of the 2010 skipjack assessment, the first since 2008. This assessment made the first use of information from the recent tagging programme as well as new analyses of fishery-related data. The results, suggesting less scope to increase catches than had previously been thought, attracted considerable interest, although the assessment clearly indicated that the stock was not in an overfished state, and not being overfished.

Other matters

We noted in last year's report the nomination of a new Vice-Chair of the SC, Pamela Maru of Cook Islands. Pam was the first Pacific Islander in a leadership position in a regional fishery management organisation. Pam excelled at her role in 2010, including taking on extra responsibilities through a secondment to the WCPFC Secretariat in the lead-up to the meeting. The confidence that the SC had in her performance was demonstrated in the nomination of both her and Vanessa Marsh (Niue) as co-conveners of the Data and Statistics Theme for 2011 and beyond.

Subject to the approval by the Commission, the next SC meeting will be held in Palau in August 2011.

[1] The meeting's summary report and meeting papers can be found at http://www.wcpfc.int/meetings/2010/6th-regular-session-scientific-committee

Regional workshop on CITES non-detrimental findings for marine-listed species

The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Hard corals are listed under CITES.

Hundreds of species from the Pacific are listed under CITES (hard corals account for most of those) and are commonly traded from over 10 countries in the region. The CITES-listed species most commonly traded from the Pacific are stony corals and giant clams. These species are exported live for the aquarium trade[1] and dead (or shells) for the curio trade, and form the basis of commercial activities that generate revenues in both rural and urban areas. These species are also used for traditional and cultural purposes. Other species such as tree ferns, parrots and orchids are also traded but not as widely.

Not all Pacific Island countries are signatories to CITES. Those that aren't still need to comply with CITES documentation, which is demanded by importing countries. For example, although Solomon Islands exports a number of CITES-listed species, it has only recently joined the convention (2007). The Federated States of Micronesia, the Republic of the Marshall Islands and the Kingdom of Tonga still are not parties. Unfortunately, even when corals or clams are produced or harvested sustainably, exports are harder to monitor from non-party countries, sometimes resulting into trade bans generated by importing countries.

Pacific countries that are signatory to CITES.

Country	Signatory year
Australia	1976
Fiji	1997
France (including its Pacific dependents)	1978
New Zealand (including its Pacific dependents)	1989
Palau	2004
Papua New Guinea	1976
Samoa	2004
Solomon Islands	2007
United States of America (including its Pacific dependents)	1975
Vanuatu	1989

Presenting non-detrimental findings (NDF) is a process that must be carried out before exporting a CITES-listed species. Essentially, NDF is a science-based risk assessment that focuses on examining the harvest,

[1] Live rocks are also listed under CITES

population responses, measures and risks in order to determine whether or not removal of a species from the wild is detrimental. An NDF is achieved if population trends (or indicators), despite any harvesting of a species, are increasing or stable. Any risks should be effectively mitigated and addressed. However, in the Pacific region, there often is a lack of capacity to do so. As a result, CITES decided together with the Secretariat of the Pacific Regional Environment Programme (SPREP) and SPC, to hold a series of workshop related to CITES mechanisms used for marine species.

In August 2009, a regional workshop on managing sustainable fisheries for giant clams (Tridacnidae) and CITES capacity building was held in Fiji.[2] In May 2010, a workshop was held in Solomon Islands, training competent Pacific authorities (scientific and management authorities) on NDF. This meeting was attended by regional fisheries and environment department participants from 12 countries.[3] Resource people from the International Union for Conservation of Nature (IUCN), the US National Oceanic and Atmospheric Administration (NOAA), and the University of the South Pacific (USP) assisted SPREP and SPC in facilitating the workshop.

After general CITES presentations by Robert Boljesic and specific trade presentations provided by present parties, the focus was on providing NDF training. Helen Pippard from IUCN–Fiji took a lead role in the sessions and coordinated group work related to this topic. She also gave several technical presentations and steered working groups.

Essentially, NDF is a science-based risk assessment that focuses on examining the harvest, population responses, measures and risks in order to determine whether or not removal of a species from the wild is detrimental. An NDF is achieved if population trends (or indicators), despite any harvesting of a species, are increasing or stable. Any risks should be effectively mitigated and addressed. Workshop participants were invited to gather in country or cultural region groups to work through NDF related to specific issues.

Further, a range of background and informative presentations were provided during the meeting. They can be downloaded from SPC's aquaculture website at: www.spc.int/aquaculture

Aquarium Arts (AA) — a large live fish and coral export facility — in Honiara, Solomon Islands generously allowed workshop participants onto its premises. AA is managed by Willie Veitch. Another company (Solomon Islands Marine Exports, a coral collecting company) jointly operates from AA facilities. Willie had prepared copies of unused CITES permits and an informal group discussion ensued between him and the participants. The group also toured the facility and learned about fish and coral handling prior to export. Paul Saelea from Solomon Islands Marine Exports showed his company's activities and some of the products it was shipping. Everyone gained knowledge and hands-on experience to what trading CITES-listed species really means.

The giant clam and NDF workshops are important steps forward to understanding CITES-based mechanisms for exporting marine life from Pacific Island countries and territories. Approximately 350,000 pieces of live coral and giant clams are exported from the region each year.[4,5] In addition, several tonnes of coral skeletons and clamshells are also exported for the curio trade.

Group work on non-detrimental findings (NDF) topics.

[2] Kinch J. and Teitelbaum A. 2010. Proceedings of the Regional Workshop on the Management of Sustainable Fisheries for Giant Clams (Tridacnidae) and CITES Capacity Building 4–7 August 2009, Nadi, Fiji.

[3] Australia, Cook Islands, Fiji, French Polynesia, Marshall islands, New Caledonia, Palau, Papua New Guinea, Samoa, Solomon Islands, the USA and Vanuatu

Participants to the workshop came from 12 different countries.

Live rocks are also listed under CITES and are exported in large quantities (1,000 t per year on average). Understanding the trade of these species will ensure that competent scientific and management authorities in the Pacific will improve the monitoring of the industry and ensure maximum benefits to communities and local businesses, while harvests and production are carried out sustainably.

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A change at the helm of SPC's Aquaculture Section

SPC bids farewell to Ben Ponia, who was the Aquaculture Adviser for almost nine years. With the support of his staff, he put aquaculture back on the map in the Pacific. Ben was also able to compile the most accurate statistics on aquaculture production for the Pacific over the period 1998–2007[6]. Ben left SPC to take up the position of Secretary of Marine Resources in the Cook Islands. All staff at SPC's Coastal Fisheries Programme wish Ben well in his new role, and look forward to working with him and his staff in the future.

Ben's replacement, Robert Jimmy from Vanuatu, is no stranger to many fisheries people in the Pacific. Robert was the Acting Director of Fisheries in Vanuatu for three years. Prior to this he was the Manager of the Research and Aquaculture Division in Vanuatu. Robert has a Master's degree in Aquaculture and Fisheries, as well as years of experience working in the aquaculture field. Coastal Fisheries Programme staff welcome Robert on board and look forward to working with him as he continues to take aquaculture in the Pacific forward.

[4] CITES WCMC Database 2010
[5] Teitelbaum and Friedman. 2008. Resurgence of cultured giant clams from the Pacific; current status and prospects for the aquarium market. Australasian aquaculture conference, Brisbane 2008.
[6] Ponia B. 2010. A review of aquaculture in the Pacific Islands 1998–2007: Tracking a decade of progress through official and provisional statistics. Aquaculture Technical Papers, Secretariat of the Pacific Community, Noumea, New Caledonia.

Communicating about coral reef issues

***Source: Reef Resilience Review. August 2010 Newsletter distributed by the Global Marine Initiative for The Nature Conservancy.*[1]**

Papua New Guinea: Puppets help save reefs

While much progress has been made in Kimbe Bay to protect its reefs, destructive fishing and overfishing still threaten general reef health. Much of the threat comes from humans who do not understand the negative impacts of their behaviors. However, savvy reef educators in Kimbe Bay realized their close connection with the reef, especially the connection children have, and created an outreach and education campaign that targets children. In the local tongue, children are Mahonia Na Dari, which translates as "guardians of the sea." They are being recruited into this role by a small conservation organization that bears the same name.[2]

The educational puppet show used in Kimbe Bay strengthened conservation messages on marine biodviersty in local schools and villages (Photo © A. Green).

The message of reef health now reaches 14,000 young Papua New Guineans every year. Schools from all over the country send classes to Mahonia Na Dari's facilities. Students are educated about the reef and then take the conservation message back to their communities.

The most effective part of Mahonia's campaign is Leni and Niko, who are two young characters in a puppet show, which tours villages and schools. Leni and Niko's antics raise plenty of laughs, while simultaneously addressing the serious issue of destructive fishing practices.

Closeup of puppets (Photo © A. Green).

The puppets were developed after teachers realized classroom style lectures were not producing the desired effect. Characters like Leni and Niko, two young boys who often cause trouble but learn valuable lessons about reefs in the end, stay in the students' minds. When students go back to their villages they tell their friends, mothers and fathers about what they learned in school, which builds community awareness and increases reef stewardship.

In addition to the puppet shows, the awareness campaigns include marine conservation messages, videos, booklets, pamphlets and other promotional materials. Both men and women are included in the project's activities. Youth and women's groups are an important part of the awareness program, as well as indigenous participation. The campaign has helped strengthen the message of marine conservation through the passing on of knowledge and general increase in marine education.

[1] http://www.nature.org/initiatives/marine/
[2] http://www.mahonia.org/

Guam: Using cartoons

Guam has chosen an accessible, iconic mascot, Professor Kika Clearwater,[3] to represent the Guam Coral Reef Initiative (CRI) Coordinating Committee. The Guam CRI is an executive order signed by the Governor of Guam in May 1997, as a policy development mechanism to protect coral reefs. The Guam CRI Coordinating Committee consists of representatives from local and federal agencies, such as Guam Environmental Protection Agency, Guam Coastal Management Program, Department of Agriculture — Division of Forestry and Division of Aquatics and Wildlife, and the University of Guam — Marine Lab.

The CRI needed to communicate about the importance of coral reefs to the local community and beyond. They needed to educate children and adults about the five main threats to their reefs: land-based sources of pollution, recreation use and misuse, lack of awareness, coral bleaching and disease and global climate change. In 2004 they developed an outreach and education campaign that included the creation of Professor Kika Clearwater, a clownfish who is the icon of the Guam CRI. Her tagline is "Our coasts. Our future." and she is featured on all public outreach materials with a message that highlights the importance of natural resource management.

To target young audiences, Professor Kika Clearwater has her own page on MySpace, a social networking website. The MySpace page allows for links to international awareness campaigns about coral reefs and the environment in general. The campaign also engages community volunteers in several hands-on environmental activities throughout the island.

Public support and community involvement have been an essential component of the CRI. One of the programs focuses on increasing public awareness of coral reef ecosystems and their relationship to Guam's watersheds through innovative environmental education and outreach efforts. The Environmental Education Committee (EEC) of the Watershed Planning Committee (WPC) serves as the coordinating body. The EEC consists of representatives from local and federal government agencies, non-governmental organizations, private businesses, educators, and concerned citizens.

In addition to their many outreach efforts, the Guam Coastal Management Program[4] has led efforts to implement a comprehensive public education and outreach campaign about coastal management issues. The campaign uses a variety of outreach tools to publicize messages across to various stakeholders including: a quarterly newsletter entitled "Man, Land and Sea," radio talk shows, theater intermission and tourism ads, in-flight videos, posters, publications, and a puppet show that travels around the island to educate children about the importance of protecting Guam's watersheds and coral reefs.

Australia: A country becomes a steward

The Great Barrier Reef Marine Park Authority (GBRMPA) undertook the most comprehensive campaign for community involvement and participatory planning for any environmental issue in Australia's history; including two phases of public consultation and a huge amount of ongoing public education for their re-zoning process. It was intensely stakeholder driven with different community groups being informed at each major milestone in the planning process. The methods used to communicate with these groups included:

- A series of technical information sheets that helped educate the public about the reasons behind re-zoning and key aspects of the planning program;
- The Draft Zoning Plan that was publicly released;
- The Revised Zoning Plan;
- Periodic re-zoning update brochures that were distributed throughout the planning program; and
- Background publications/papers that were released to the public on the participation process and lessons learned.

The GBRMPA also strives to keep all information transparent and accessible by constantly updating its website. GRMPA has also made efforts to capture "lessons learned" in multiple documents over the years. Some of the lessons learned are:

- There is no simple way of creating a conflict-free consultative mechanism for large complex areas.

[3] http://www.guamiyor08.com/kika.html
[4] http://coastalmanagement.noaa.gov/mystate/guam.html

Aerial view of the Great Barrier Reef. Photo © Nickj

- People needed to understand there was a problem before accepting that a solution was required.
- Due to a lack of awareness and understanding of the key issues by many stakeholders, public communication and information sharing was critical. The re-zoning process was not about managing fisheries, but rather about protecting biodiversity.
- Different messages were needed for different target audiences.
- Some elements of the community information sessions were more successful than others; for example, the format that focused on individual discussions rather than a speaker podium at which stakeholders could publically vent was more productive.
- Some people supported the proposed increase in protection but would not openly state their views because of peer pressure.
- Need to anticipate a large number of submissions/ suggestions from different user groups.

For more details about these and other lessons learned on this major community awareness strategy see pages 7–10 in the Representative Areas Program: An Ecosystem Level Approach To Biodiversity Protection Planning[5] and pages 4–8 in Barriers to Communication: How These Critical Aspects Were Addressed During the Public Participation for the Rezoning of The Great Barrier Reef Marine Park.[6]

For more information on the latest outcomes and information regarding the public awareness campaign and the GBRMPA, see the "Outlook Report" for the Great Barrier Reef, which was published in 2009.[7]

[5] http://www.gbrmpa.gov.au/__data/assets/pdf_file/0005/8249/ITMEMS_paper_23_Mar03_Comp_lf-1.pdf
[6] http://www.gbrmpa.gov.au/__data/assets/pdf_file/0016/8251/Breaking_through_the_barriers_15April0420FINAL.pdf
[7] http://www.gbrmpa.gov.au/corp_site/about_us/great_barrier_reef_outlook_report

Fiji launches milkfish aquaculture project for food security

Gerald Billings (Senior Fisheries Officer Aquaculture, Government of Fiji) and Tim Pickering (SPC Aquaculture Officer)

A new community-level mariculture project that is directly aimed at food security has been initiated in Fiji this year. The Vitawa Aquaculture Development Project at Vitawa Village in Ra Province was officially opened on 5 March 2010 by Fiji's Minister for Primary Industries, Joketani Cokanasiga, upon completion of three nursery ponds and three grow-out ponds worth FJD 54,000 that have been under construction since late 2009.

Fiji's Minister for Primary Industries, Joketani Cokanasiga with JICA Official Supporter, judo champion Sisilia Naisiga, resident JICA representative Jiuchiro Sasaki, and FAI director Hideyuki Tanaka examine milkfish fingerlings caught near Vitawa and ready for release into the project's culture ponds.

The project intends to raise milkfish *Chanos chanos*, which can be caught in abundance as small fingerlings on intertidal mudflats in the surrounding area. The Japan International Cooperation Agency (JICA), the South Pacific Liaison Office for Fisheries and Aquaculture International (FAI), and the Fiji Department of Fisheries collaborated to construct the farm and to train villagers on milkfish capture and culture techniques. Resident JICA representative, Jiuchiro Sasaki, and FAI director, Hideyuki Tanaka, were also present at the Opening.

The project cost is about FJD 400,000 and is being funded by JICA with the aim of improving the lives of the villagers. It is a food security project operated by the Vitawa community, as a low-cost way to increase the amount of fresh fish available to village households.

"The major concern of the people of Ra was the decrease of coastal fisheries resources due to over fishing and the illegal use of dynamite," said Mr Cokanasiga. "Milkfish is one of the most important aquaculture species globally, and is a successful industry in Asian countries like Philippines, Taiwan and Indonesia."

Previous surveys by Fiji Department of Fisheries had showed that other possible milkfish fry collecting grounds for pond-based culture in Viti Levu are Nasese in Suva, the Sigatoka River mouth, Raviravi near Ba, Deuba River mouth, and Tokotoko. In Vanua Levu, Nakalou Village, Lekutu and Dreketi areas are potential sites for fingerling collection.

The culture pond system for milkfish constructed at Vitawa village in Fiji.

Freshwater aquaculture for food security is not a new concept in the Pacific region although mariculture projects have generally tended to be high-tech operations that raise high-value species for commercial sale or export. If mariculture for food security is to be successful, it is important that costs be kept low. The goal of JICA and FAI training to the Vitawa farm managers is to avoid the use of fish feed that must be bought with "money-up-front" by the participating community. Careful pond management techniques to encourage algae and plankton blooms are being demonstrated so that fish can be grown entirely on natural food. Water in ponds is exchanged by tidal flushing, so no pumps are needed.

Mr Cokanasiga continued, "This Vitawa Aquaculture Development Project is geared for the utilization of land (mudflats), using the abundance of milkfish fingerlings present in the surrounding areas, and it will assist in addressing present scarcity of readily available fish for food security, with later plans to expand the venture into an income generating scheme."

"For the maximum utilization of the fish ponds, there are opportunities to expand and develop through polyculture the farming of milkfish, but like all other projects, challenges and problems need to be overcome first, before we consider extending this activity to other areas in the country."

"Whilst this is the beginning, we hope that JICA will look at the long-term development of projects of this nature and continue its support for at least another five years. This will be in terms of training and development of further projects in order to sustain the development of marine resources in this part of Viti Levu," added Mr Cokanasiga.

The first harvest of milkfish stocked into the Vitawa ponds was expected to take place in August this year, however some initial teething problems have been encountered in pond management, which reduced the growth rate and survival of the first batch of fish. Participants have gained experience in managing pond water exchange for the purposes of maintaining algal blooms adequate for fish nutrition, and providing adequate water exchange to mitigate high evaporation rates and consequent high seawater salinity for which some inshore localities of Ra Province are famous.

*Milkfish (*Chanos chanos*) fingerlings caught from surrounding mudflats. This size is useful for stocking culture ponds.*

Global Aquaculture Conference and FAO COFI Sub-committee Meeting on Aquaculture in Thailand

Tim Pickering (SPC Aquaculture Officer)

There have been four major milestones in the history of aquaculture development: 1) the FAO Technical Conference on Aquaculture and Kyoto Declaration of 1976; 2) the Code of Conduct for Responsible Fisheries in 1995; 3) the Conference on Aquaculture in the Third Millennium and the Bangkok Declaration and Strategy (BDS) of 2000; and 4) the establishment of the United Nations Food and Agriculture Organization (FAO) Committee on Fisheries (COFI) Sub-committee on Aquaculture as the only international governmental forum for discussion of aquaculture development issues.

The Global Aquaculture Conference and Phuket Consensus 2010 will be the fifth milestone. The purpose of the conference and consensus is to 1) review the progress in addressing the Millennium Development Goals (via aquaculture) against targets set by the BDS, and 2) re-assess the priorities for international efforts to further the development of aquaculture for people and food. Among other things, it is proposed that Africa be regarded as a "least aquaculturally developed" region that needs priority treatment under international efforts to further develop aquaculture.

SPC and FAO jointly funded five SPC member country representatives to attend the conference, as well as the back-to-back 5th COFI Sub-committee on Aquaculture meeting held in Phuket, Thailand. The Pacific Island countries represented were Cook Islands, Fiji Islands, Nauru, Papua New Guinea and Tonga. This is a historic event because it is the largest-ever Pacific contingent that has participated in a COFI Sub-committee on Aquaculture meeting.

The idea for a Global Aquaculture Conference started with the Network of Aquaculture Centres of Asia-Pacific, or NACA (of which SPC is an associate member), and the government of Thailand in 2008. A Phuket Consensus document was drafted in advance for endorsement by the conference, which was attended by 650 participants. There were 41 scholarly presentations and 10 plenary lectures at the conference, during which 20 "expert panels" were also convened. A range of keynote addresses reviewed emerging trends and development progress over the last decade against the BDS pillars. In addition, a series of participatory discussions, led by the expert panelists, developed a set of recommendations for adoption as an annex to the Phuket Consensus.

The Global Aquaculture Conference revealed that aquaculture continues to be the fastest growing food production sector in the world, although the rate of growth is now decreasing. Millions of people worldwide derive their livelihoods from aquaculture, which is a vital means for helping to keep rural areas populated. Some unexplored opportunities remain for expanding aquaculture into new species (such as striped catfish), new environments (offshore aquaculture), and new techniques (culture-based fisheries and stock enhancement are still under-developed).

Do you recognize any of these people? Sartorial elegance is personified by Pacific representatives of the 5th Session of the FAO COFI Sub-committee on Aquaculture. From left to right: Koroa Raumea (Cook Islands), Jacob Wani (Papua New Guinea), Gerald Billings (Fiji Islands), Poasi Ngalufe (Tonga), Monte Depaune (Nauru) and Tim Pickering (SPC).

New challenges since 2000 include climate change. Aquaculture can be a major climate change adaptation and mitigation strategy. Compared with other food production sectors, aquaculture provides high-quality food (in terms of nutrition), and so is a major tool to counter the "hidden hunger" of nutrient deficiencies.

A range of needs for improved aquaculture development were highlighted during the conference, including better dissemination of aquaculture technologies to small-scale farmers, less dependence upon fishmeal for feeds, and better integration of small-scale aquaculture into global markets. Aquaculture governance needs further strengthening. Ecosystem-based approaches to aquaculture need to be adopted. Biosecurity capacity must be increased, and aquatic genetic resources must always be used responsibly and equitably. More work is needed on using "alien" species for aquaculture, by addressing knowledge gaps and through adopting principles and procedures such as risk assessment and a precautionary approach. To enhance aquaculture's contribution to food security and poverty alleviation, issues of gender, youth and indigenous knowledge must be considered. It needs to be recognised that income generation through commercial aquaculture is a key element to food security through the creation of employment. Aquaculture statistics need to be improved, in particular, more information is needed along the value chain than just production values and tonnes.

In an after-hours side-meeting, FAO's sub-regional office in Samoa and SPC jointly organised an "Evening of Pacific Aquaculture", in which a group of international organisations were invited to hear Pacific Island participants explain their aspirations for aquaculture and the constraints they face. A representative of FAO's sub-regional office provided an overview of issues arising from that organisation's recent review of aquaculture in selected Pacific Island countries and territories (PICTs). Tim Pickering, from SPC, gave a short presentation that made a case for PICTs to also be considered a "least aquaculturally developed" region that needs to be given priority. The organisations present, led by FAO, responded that the Pacific is recognised as a region of great aquaculture potential and so is deserving of international support. There was agreement (in principle) to hold a high-level meeting in the Pacific in 2011 to explore ways that FAO can partner with SPC, NACA, the Southeast Asian Fisheries Development Center, Australian Center for International Agricultural Research, Australian Agency for International Aid, Japan International Cooperation Agency, WorldFish Center, and other relevant agencies to prepare a Pacific Regional Strategy and Workplan for strengthening international cooperation and involvement in regional aquaculture development.

With the adoption by the Conference of the Phuket Consensus, it was reaffirmed that the BDS will continue to provide guidance for responsible aquaculture development. Overall, progress has been achieved in line with the BDS principles. The Phuket Declaration now adds some newly emerging issues not considered in the BDS. The international aquaculture sector takes BDS into consideration and uses it to guide its actions. The Phuket Consensus 2010 is a consensus of the conference only, and is not binding, but like the BDS it will be enormously influential.

The FAO COFI Sub-Committee on Aquaculture reports to the biennial FAO Committee on Fisheries and is the means by which FAO is mandated to set priorities for assisting member states in the area of aquaculture food production. Participation by Pacific FAO members has, in the past, been scanty, although an unprecedented five SPC members were represented at this 5th session of the sub-committee.

Meeting participants heard that increased quantity of fish could, in the future, only come from aquaculture and not from fishing. Further, it will have to come from mariculture because of limits on land-based water resources. Offshore aquaculture is predicted to be a new and emerging sector for which governance arrangements may need elaboration under international law. Good governance of aquaculture is essential to ensure sustainability in accordance with the FAO Code of Conduct for Responsible Fisheries, and to avoid biodiversity problems. Climate change and variability represents a major challenge. Certification of food safety of aquaculture products will be increasingly important to reassure consumers.

FAO draft Guidelines on Aquaculture Certification had been prepared to help members assess the implications of the profusion of private certification schemes that have mushroomed in the fisheries and aquaculture sectors. The draft guidelines proved controversial however, because of concerns by some members that certification may discriminate against small-scale farmers or could be used to erect trade barriers. Considerable work was done to reach a compromise wording that, in the end, no one at the meeting was 100% satisfied with, indicating that whatever wording is adopted, will need to be skillfully written.

Biosecurity was a key theme of the conference, with requests made for assistance with strengthening national capacity and policy frameworks for implementing the Code of Conduct for Responsible Fisheries, and measures addressing biosecurity and aquaculture development. Proper use of aquaculture genetic resources was emphasised, particularly with regard to countries accessing and sharing benefits from such resources. An emerging issue for member states is that "alien" species are often being wrongly synonymised as "invasive" species. Contradictory dialogues in food security and biodiversity are confusing policy-makers. Views were expressed that aquaculture species are no different from other agricultural species that keep people from hunger, so should not be treated any differently. Meeting participants also heard that the aquaculture of alien species urgently needs appropriate guidelines to be developed that will allow governments to make considered decisions.

Other key issues in which Pacific Island states made interventions, included climate change, offshore aquaculture governance, and revised international procedures for aquaculture statistics. Several requests were made by members, including those from the Pacific, for capacity-building in the area of statistics, and for common standards on statistical guidelines. FAO noted that regional organisations such as SPC and NACA have been actively involved in the ongoing FAO aquaculture statistics review process. One achievement is the recent agreement that ornamental fish be included in future statistics, notwithstanding FAO's primary focus on food items, because of the economic importance of ornamental fish to rural livelihoods in several regions.

At the meeting, the five Pacific countries acted as a "bloc", in which each country's intervention was clearly presented as being made on behalf of other Pacific Island countries. The united stance of Pacific Island nations was a conspicuous feature of their attendance; so much so that by day two, the meeting began to refer to them as "the Pacific Islands Group". Afterward, the central Asian states (e.g. Azerbaijan, Kazakhstan) began to adopt a similar approach, using similar language as the Pacific states when making their individual interventions. At this COFI sub-committee meeting, some important markers were laid by Pacific Island representatives to help guide FAO's work in aquaculture over the next couple of years.

Papua New Guinea set to become the tuna capital of the world

Steven Poning, National Fisheries Authority Publication Officer

The fishing industry in Papua New Guinea (PNG), particularly investments in the tuna industry, will continue to grow following the path set by its well-established tuna management plans. The National Fisheries Authority (NFA) has established excellent fisheries conservation and management measures while at the same time promoting and developing onshore processing investments. PNG's tuna fisheries management and conservation measures are well recognised throughout the region.

Sylvester Pokajam, Managing Director of NFA revealed that fisheries are more sustainable than mineral extraction, and PNG — through NFA — has ensured that its marine resources are caught or harvested within limits set by management plans in order to be fully sustainable.

The PNG government signed a project agreement with Majestic Seafood Ltd for the construction of a tuna cannery in the Malahang Industrial Centre in Lae. Mr Pokajam said that "...in fisheries, our vision is: what is caught in PNG waters must be processed and exported so that revenues are fully maximised in PNG". "We want down-stream processing so that money is circulated within the country by way of providing spin-off benefits and employment opportunities", he added.

Ground breaking ceremony at the Majestic Seafood cannery construction site.

The cannery will be built in two stages: at the end of the first phase, the factory should reach a processing capacity of 150 t of tuna per day, which will rise to 350 t/day when the second phase is completed. It is expected that this new cannery will create close to 7,000 jobs.

Two more tuna processing operations will be established in Lae at Malahang once all formalities are completed.

1. IFC (International Food Corporation), which already produces canned mackerel, will add a tuna processing line to their factory. It will process 150 t of tuna per day.
2. Zhoushan Zhenyang Deep-Sea Fishing Company will build a plant to process 250–300 t/day. The new plant will employ 3,000 local workers.

Augusto Natividad, Director of Majestic Seafood, said that between his company and the other two companies, Lae alone will be bale to process 750 t of tuna per day. He said this will be great, as it will almost reach the production levels of the Philippines.

Speaking during the ground breaking ceremony of Majestic Seafood Limited in the Morobe Province, the Minister for Fisheries, Mr Ben Semri announced that investors in the fisheries sector are stepping into PNG because of the conservation and management plans for fisheries and marine resources that are in place and also because of the government policy in this sector. Mr Semri said the National Fisheries Authority has done a lot in terms of developing the fisheries sector and he thanked the Managing Director of National Fisheries Authority, Mr Sylvester Pokajam, for it.

[1] A joint venture between Thai Union Manufacturing Co., Ltd., a subsidiary of Thai Union Frozen Products PCL., Century Canning Corporation Co., Ltd., and Frabelle Fishing Corporation, Ltd. established Moresby International Holdings, which in turn established Majestic Seafood Corporation in PNG. Each partner invests in 33.33% of the total registered capital of USD 1,500,000. The purpose of Majestic Seafood Ltd is to manage tuna fishing businesses in PNG waters and surrounding areas as well as sourcing raw materials needed for manufacturing. PNG has an abundant supply of tuna resources, enabling Majestic Seafood Ltd to have greater access to raw materials. In addition, products manufactured and exported from PNG to European countries are eligible for custom duty privileges.
(Source: Thai Union Frozen Products PCL. website: http://www.thaiuniongroup.com/home/home.php?pro=company, visited 11 October 2010)

New research plan provides a blueprint for addressing shark issues in the western and central Pacific

Shelley Clarke

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The Western and Central Pacific Fisheries Commission (WCPFC) has taken a major step toward addressing concerns about shark populations with initial approval of a three-year Shark Research Plan by its Scientific Committee (see Useful Shark Links, #1). The plan will be led by the Oceanic Fisheries Programme of the Secretariat of the Pacific Community, and will contain assessment, research coordination and fishery statistics improvement components. The overall aim of the plan is to evaluate the status of blue, mako, oceanic whitetip, silky and thresher sharks in the western and central Pacific Ocean (WCPO) and to establish better datasets to support future assessments. Following its recent endorsement by the Scientific Committee, the Shark Research Plan will be presented for full Commission approval at its annual meeting in Hawaii in December. This article outlines the background and context of shark issues in the WCPO, introduces the key species and previews the forthcoming assessment work.

Introduction

Sharks are among the species to be managed by regional tuna fisheries management organisations (RFMOs) but little has been done worldwide by these organisations to manage shark catches. In fact, because so few national fisheries catch reporting systems record sharks, RFMOs often lack sufficient data upon which to draw conclusions about the status of shark stocks. At the same time, there are increasing concerns about fisheries targeting sharks and about continued growth in the shark fin trade. In the WCPO, two species of sharks are categorised by the International Union for Conservation of Nature (IUCN) Red List as globally endangered and another sixteen as globally vulnerable (see Useful Shark Links, #2), and it is not difficult to predict that catch limits may, in future, be required to safeguard some stocks. The current challenge facing the WCPFC is to find the proper balance between shark conservation and utilisation, given the considerable uncertainty regarding the current status of stocks (Fig. 1).

Figure 1. What should be done about sharks? Heavy fishing pressure is believed to be threatening some shark populations.

Shark management options

Within the overall shark policy debate, one of the most contentious issues is which organisation should take charge of management. Some conservation advocates, frustrated with what they see as the "failure" of RFMOs to protect stocks from overfishing, have lobbied for listing sharks and other fished species by the Convention on International Trade in Endangered Species (CITES). Three large and charismatic shark species (basking, whale and great white sharks) have already been listed by CITES (see Useful Shark Links, #4) but these species do not appear frequently in catch records from longline or purse seine-based tuna fisheries. At the March 2010 CITES meeting, proposals for eight sharks, most of which are common bycatch species in tuna fisheries, were debated but none gained the necessary votes for listing. Another tool for shark protection is the Convention on Migratory Species (CMS) on which seven shark species — three of which are potential tuna bycatch species — are listed (see Useful Shark Links, #5). Another approach, proposed in a forthcoming paper in the journal Marine Policy, rejects management options under all existing organisations and calls for the creation of a new "International Commission for the

Figure 2. Finning involves discarding the shark carcass at sea (left). Bringing the shark to shore, removing the fins and disposing of the carcass on land is not finning (right) (see Useful Shark Links, #3).
(Images sources: left – Nancy Boucha, www.scubasystems.org 2005/Marine Photobank; right – www.sharks.org/news/051213.htm)

Conservation and Management of Sharks", based on the International Whaling Commission.

Such potential threats to the management authority of RFMOs for highly migratory fished species have perhaps helped to foster consensus among WCPFC members that the Commission needs to do more to address shark issues. WCPFC's existing shark conservation and management measure (CMM 2009-04, see Useful Shark Links, #1) is similar to that adopted by other RFMOs in that it discourages waste and discards, encourages live release, and controls finning (i.e. cutting off a shark's fins and discarding its carcass at sea (Fig. 2), but it does not limit shark catches per se. The measure also specifies national catch reporting practices that are voluntary rather than required. Development of the WCPFC Shark Research Plan (see Useful Shark Links, #1) is designed to support the existing management measure, but at the same time it moves beyond the current utilisation-focused RFMO approach by proposing the most ambitious shark assessment programme of any of the tuna RFMOs. If formally endorsed and funded by the Commission in December, the Shark Research Plan will produce assessments for eight key shark species identified by the Commission (Fig. 3) and lay a solid research foundation to support future assessments.

WCPFC key shark species

Under Article 1 of its Convention, the WCPFC is responsible for managing highly migratory fish stocks, which are defined as those listed in Annex 1 of the United Nations Convention on the Law of the Sea (UNCLOS), as well as such other fish species as the Commission may determine. UNCLOS Annex 1 specifies that oceanic sharks consisting of bluntnose sixgill (*Hexanchus griseus*); basking shark (*Cetorhinus maximus*); threshers (Family Alopiidae, 3 species); whale shark (Rhincodon typus); requiem sharks (Family Carcharhinidae, 52 species); hammerheads (Family Sphyrnidae, 9 species) and lamnids (Family Isuridae [Lamnidae], 5 species) should be covered — in total, 72 species.

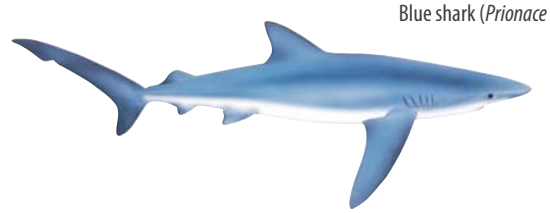
In order to focus and prioritise this list, WCPFC has developed a list of key shark species. These species were selected because they are 1) considered to be at high risk from fishing activities based on an ecological risk assessment project conducted by SPC (2006–2009); 2) most readily identified (thereby most likely to appear in logsheet and observer datasets); and 3) frequently reported in annual catch data provided by Commission members. The WCPFC key shark species currently include blue, silky, oceanic whitetip, shortfin mako, longfin mako, bigeye thresher, common thresher and pelagic thresher (Fig. 3).

In December 2009, the Commission requested its Scientific Committee to consider designating other shark species, including porbeagle (*Lamna nasus*) and hammerheads (Family Sphrynidae, nine species), as key shark species. Based on the known distribution of these species, these ten can be reduced to five species that occur within the WCPO: porbeagle (*Lamna nasus*), winghead hammerhead (*Eusphyra blochii*), great hammerhead (*Sphyrna mokarran*), scalloped hammerhead (*S. lewini*) and smooth hammerhead (*S. zygaena*). The Scientific Committee recommended that these five species be referred to the Commission meeting for addition to the key species list. However, the need for a formal process to evaluate whether additional sharks should be added to the key species list was also recognised. OFP will develop such a process for further consideration at the next meeting of the Scientific Committee in August 2011.

State of the data

One of the objectives of the Shark Research Plan is to examine the available shark information. OFP has reviewed catch and effort data, and fishery-specific and non fishery-specific biological data, to determine

Blue shark (*Prionace glauca*)

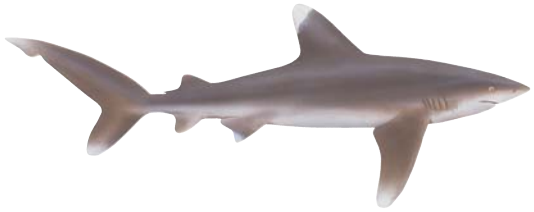


A widely distributed, temperate and subtropical species with high productivity compared with other sharks, the blue shark is the most common species in WCPO observer records for longline fisheries. Assessments for the North Pacific and Atlantic indicate that the biomass of this species is probably above the maximum sustainable yield level and overfishing is probably not occurring. Nevertheless, the blue shark is classified as "Near Threatened" by the IUCN Red List.

Silky shark (*Carcharhinus falciformis*)

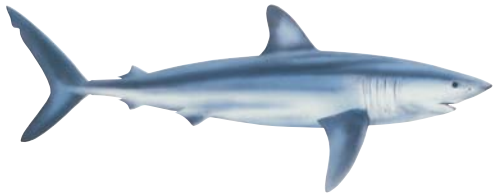
This widely distributed, subtropical species is commonly observed in both longline and purse-seine fisheries but is considerably less productive than the blue shark. Preliminary assessment work is underway by the Inter-American Tropical Tuna Commission (IATTC) for the eastern Pacific Ocean (EPO). The silky shark is classified by the IUCN Red List as "Near Threatened" globally, but "Vulnerable" in the eastern, central and southeast Pacific.

Oceanic whitetip shark (*Carcharhinus longimanus*)



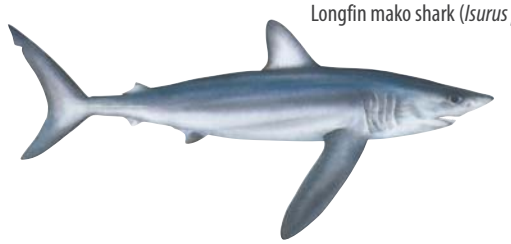
This subtropical species is similar in productivity to the silky shark and is the second most commonly noted shark in longline observer records. Localised depletions of oceanic whitetips have been reported in the Atlantic and it was unsuccessfully proposed for CITES listing (Appendix II) in 2010. It is classified by the IUCN Red List as "Vulnerable".

Shortfin mako shark (*Isurus oxyrinchus*)



This shark is similar to the blue shark in distribution, and to the silky and oceanic whitetip sharks in its relatively low productivity. It is commonly noted in longline observer records and is listed on CMS (Appendix II). Assessments for the Atlantic have produced highly uncertain results but several scenarios indicated that the biomass of this species is below the maximum sustainable yield level and overfishing is occurring. The shortfin mako is classified by the IUCN Red List as "Vulnerable".

Longfin mako shark (*Isurus paucus*)

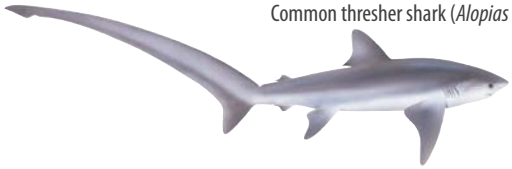


Little is known about this close relative of the shortfin mako except that it may be a deeper dwelling species; many records do not distinguish between the two. The longfin mako is also listed on CMS (Appendix II) and classified as "Vulnerable" by the IUCN Red List.

Bigeye thresher shark (*Alopias superciliosus*)

This species is believed to have the lowest productivity of the key shark species because it grows more slowly, reaches maturity later and is smaller than the other threshers. Few estimates of catch are available due to a lack of species-specific reporting. The International Commission for the Conservation of Atlantic Tunas (ICCAT) has prohibited catches of bigeye thresher since June 2010. This species is classified by the IUCN Red List as "Vulnerable".

Common thresher shark (*Alopias vulpinus*)



Although information about this species is limited, it is known to be the largest of the three threshers and believed to be more productive than the bigeye thresher. ICCAT discourages directed fishing for this species. The IUCN Red List classifies the common thresher as "Vulnerable".

Pelagic thresher shark (*Alopias pelagicus*)

Unlike the other threshers, the pelagic thresher is mainly distributed in tropical waters. Similar to the other threshers, productivity is low relative to other sharks and species-specific catch records are lacking. The pelagic thresher is also classified by the IUCN Red List as "Vulnerable".

Figure 3. Current list of WCPFC key shark species.
(Graphics by Les Hata, © SPC and Hawaii Division of Aquatic resources)

whether these are sufficient to support stock assessments for the WCPO. This review highlighted several critical gaps including:

- Mis-identification and under-reporting of shark catches (e.g. not reporting any shark catches or reporting all shark species in a single category of "shark [unidentified]");
- Some Commission members, which are reported in FAO databases as being among the world's leading shark fishing nations, submit no shark catch data to the Commission;
- Most logsheet catch data are provided in a summarised format, rather than set-by-set, which makes it difficult to properly account for changes in fishing techniques or targeting strategies. These changes can strongly affect the abundance indices used in population modeling;
- Onboard observers usually provide the best source of data for shark assessment but coverage of longline fleets, which account for much of the shark catch, is low and does not represent all areas where sharks are caught (Fig. 4);

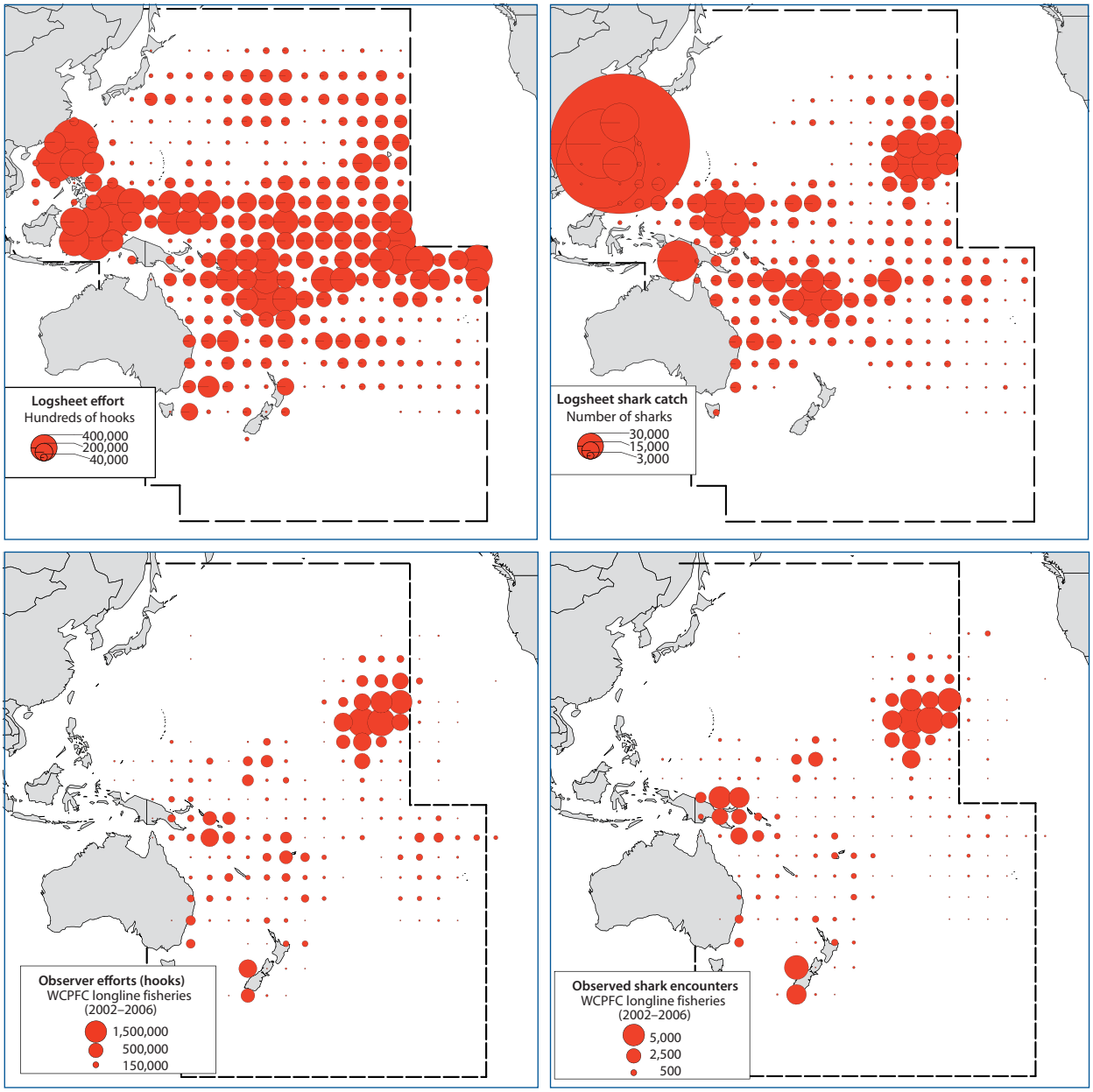


Figure 4. Longline effort from logsheets (top left), reported shark catches from logsheets (top right), longline observer coverage (bottom left), and shark encounters (presence or absence) recorded by observers (bottom right) for 2002–2006. Note the differences between the patterns in the observer data in the bottom two panels and the patterns of longline effort and logsheet-recorded shark catch shown in the top two panels.

- Biological information and tagging data are lacking for some of the rarer key shark species such as the longfin mako and the threshers.

In recognising these critical data gaps, Commission members have already taken several steps toward addressing them. First, observer coverage rates will improve under tuna conservation and management measures adopted by the Commission in 2007, which require 100% coverage of the purse-seine fishery as of 1 January 2010 and 5% coverage of the longline fishery (up from the current 1–2%) by June 2012. However, since the vast majority of sharks are caught by the longline fishery, further increases in longline observer coverage and representativeness would substantially improve knowledge about the status of sharks.

Second, during a special session at the Scientific Committee meeting in August, Commission members agreed to 1) investigate and remedy gaps in their own provision of data; 2) explore new sources of supplemental shark data such as recreational catch records and biological studies conducted by national academic researchers; and 3) consider summarising and coordinating tagging programmes on a regional level.

Finally, and perhaps most importantly for sharks, the Scientific Committee recommended that national data provision requirements in the existing conservation and management measure for sharks be strengthened from voluntary to mandatory. If approved at the Commission meeting in December, this single change in policy will represent a huge breakthrough in the Commission's ability to gather the data necessary for scientifically sound assessments.

The proposed shark assessment programme

The Shark Research Plan proposes a three-step assessment programme that begins with simple, indicator-based assessments (Step 1) followed by more complex assessments of those species for which there are sufficient data. As the results of research coordination and improved data from fisheries become available, existing assessments can be updated and improved, and new types of assessments may become feasible for some species. OFP will present preliminary results from Step 1 at the annual Commission meeting in December 2010.

Step 1 assessments will consider the following indicators:

- Trends in shark catch by gear type, flag state and area may be strongly influenced by logsheet reporting practices but can provide useful insights for some fisheries.
- Trends in catch per unit of effort are a common indicator of stock status in exploited fish populations and will be computed from observer data.
- Trends in the size of captured sharks can be used to infer the extent of stock exploitation.
- Trends in the proportion of the population that has reached sexual maturity and the sex ratio of the population can have important implications for stock production.
- A measure of fishing effort relative to areas of highest shark density can provide information on the potential risks posed to the stock by fishing.
- Formal approval and funding of the Shark Research Plan will trigger assessment Steps 2 (revised risk assessments) and 3 (stock assessments). Given the data gaps already identified, it is clear that the use of existing data alone is unlikely to produce meaningful results for some of the key species. One proposed strategy is to conduct combined assessments for the two mako species, and the three thresher species (Fig. 5), respectively. Another proposed strategy is to phase the assessments so that those species with the most data are assessed first, leaving more time for new information to be identified, obtained and prepared for data-deficient species.

Figure 5. This Alopias *species represents one of three thresher shark species that will be assessed as a group under the proposed Shark Research Plan. (Image: Igone Ugaldebere / www.idivesharks.com)*

Work will begin on silky and oceanic whitetip sharks in 2011 in order to capitalise on similar assessments planned for the eastern Pacific by the Inter-American Tropical Tuna Commission (IATTC). A blue shark assessment will then be initiated in 2012, followed by mako and thresher assessments. A final element of the strategy to combat data deficiencies involves the choice of methods. Bayesian methods will be incorporated to better account for data uncertainties, and both surplus production and simple age-structured models will be applied in order to compare and contrast results and evaluate the strengths and weaknesses of each model structure.

Conclusion

Despite a number of obstacles in the form of data deficiencies, which currently block the path toward understanding the status of shark stocks, the Shark Research Plan is an important first step for the WCPFC. The plan not only outlines an assessment programme using existing available data, it also provides an essential framework for improving these data in the short and long term. Steady progress in both areas, and continuation of the momentum gained through decisions made by the Scientific Committee, will be necessary to assist the Commission in meeting its responsibilities for ensuring the sustainability of shark stocks in the region.

USEFUL SHARK LINKS:

1. The full text of the WCPFC Shark Research Plan can be downloaded from http://www.wcpfc.int/node/2950 and the existing WCPFC Conservation and Management Measure for Sharks is available at: http://www.wcpfc.int/doc/cmm-2009-04/conservation-and-management-sharks. A Pacific Islands Regional Plan of Action for Sharks can be found at http://www.ffa.int/sharks.
2. The International Union for Conservation of Nature (IUCN) maintains a "Red List" of threatened species containing assessments for 1,044 shark, skate and ray species including 181 species classified as "critically endangered", "endangered" or "vulnerable": http://www.iucnredlist.org/about/red-list-overview
3. The IUCN's Shark Specialist Group website provides more information on shark finning bans and management options for RFMOs: http://www.iucnssg.org/index.php/conservation
4. The Convention on International Trade in Endangered Species (CITES) has listed three shark species (basking, great white and whale shark) on its Appendix II: http://www.cites.org/eng/app/e-appendices.pdf
5. The Convention on Migratory Species (CMS) has listed the three CITES-listed sharks species plus shortfin mako (*Isurus oxyrinchus*), longfin mako (*Isurus paucus*), porbeagle (*Lamna nasus*) and spiny dogfish (*Squalus acanthias*): http://www.cms.int/pdf/en/CMS1_Species_5lng.pdf

An overview of toothed whale depredation mitigation efforts in the Indo-Pacific region

Geoff McPherson,[1] *Global Detection Systems* ***and Dr Tom Nishida,***[1] *Far Seas Fisheries Lab*

Depredation by toothed whales

The extent of depredation on longline catches throughout the Indo-Pacific has been summarised by Nishida and Shiba (2005) and Nishida (2007). Depredation rates of up to 25% were reported for yellowfin tuna within Seychelles waters annually, and up to 100% on a daily basis.

False killer whales depredating a black marlin on a longline.

Depredation takes the form of bait loss or target fish loss. The result is the same: lost product and probably enhancement of toothed whale populations.

The mechanism of depredation is not well known. Toothed whales may encounter a longline randomly or may detect fishing operation sounds from a vessel, sonar equipment or struggling fish as well as vessel lights. Only one study has conclusively demonstrated a link between a vessel's acoustic signature and toothed whale depredation, namely an engine or hull wallowing sound at the beginning of fishing operations. One study demonstrated the attraction of albacore tuna to an acoustic signature of a troll vessel's gearbox.

More acoustic work is required. All methods to minimise detection of fishing operations by toothed whales are probably worthwhile.

Passive acoustic reflector systems

Based on Japanese longline fishery experience, Nishida and Tanio (2001) determined that since 1959, commercial fishing experience has been that tail-wrapped fish are often not depredated upon when trace wire and gear is wrapped around and along the body length of each fish. Nishida (2007) observed that longline target fish species entangled in fishing gear that included metallic components were usually not depredated upon. Fish entangled in monofilament gear, however, were usually depredated upon. The status of longline fishery depredation mitigation work around the Indo-Pacific by 2007 was summarised by the Indian Ocean Tuna Commission Depredation Workshop (Nishida 2007). This workshop described at least three mitigation methods under development that involved the entangling of captured fish with a variety of materials. Additional methods were considered although they were never regarded as being suitable for pelagic longlining operations.

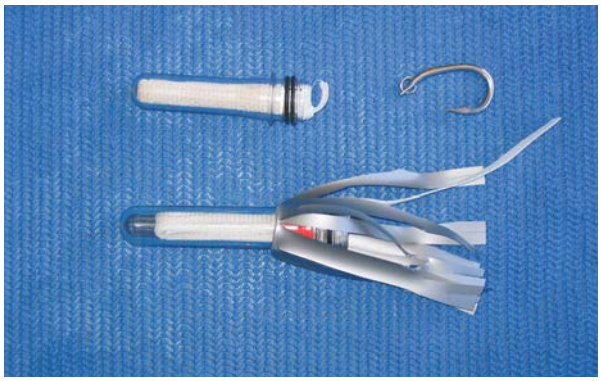
McPherson et al. (2007, 2008) described the sonar basis for toothed whale depredation. Even in clear oceanic waters, toothed whales use their sonar systems during depredation events. The sonar target strength[2] and target definition of the point of attack in hooked tuna was discussed, and helped explain why fishermen observe that whales can detect swallowed hooks and also conduct depredation during hours of darkness. Therefore, what may appear to be a mechanical impediment to depredation is, in fact, a passive sonar reflector of variable capability.

McPherson et al. (2008) described a streamer system based on electric fence tape that had been trialed in the Coral Sea for approximately 50 fishing sets. Streamers of electric fence tape with broadly distributed stainless steel wire to maintain target strength were deployed from a polycarbonate tube. When a fish strikes, the streamer is pulled from the tube and entangled around the tuna.

Variations of streamer holders included hollow plastic squid lures. Variations on streamer types were also used where both visual and presumed acoustic reflection was maximised to offer a combined mechanical and acoustic impediment to depredation. Attachment complications occurred when branchlines were made entirely of monofilament, in some instances this was done because of regulatory requirements.

[1] The authors were presented with the International Fishers Forum 5 Award (Taipei 2010) for work done on depredation mitigation in the Indo-Pacific.

[2] Target strength is a measure of the reflecting power of a sonar target, which is expressed in decibels. The target definition is the number of peaks or highlights in the return signal.



Two variations of polycarbonate streamer containers holding wire-embedded electric fence tape. The typical hook-to-tube distance was 50 cm.

A deployed electric fence streamer that tangled around free-swimming tuna, dolphin fish and swordfish during Coral Sea operations.

At the end of the experiment, it was fond that depredation appeared to be reduced even to the point of toothed whales terminating an attack on a tuna despite initial bites on the fish. The cost of the tube and variations was always low for better incorporation into the fishing industry. Despite the small size of the tubes (125 mm long x 22 mm in diameter) the space occupied by hundreds of tubes hanging off the outside of branchline stacking boxes on deck became logistically difficult.

Research conducted in Seychelles waters demonstrated that a streamer device of multiple strands of monofilament, referred to as a "spider", had considerable potential to reduce depredation rates (Guinet 2007; Rabearisoa et al. 2009). The spider was maintained a few metres from the hook, and slid down over the hooked fish after the bait was attacked. The streamers were of low sonar target strength stiff monofilament.

Rabearisoa et al. (2009) concluded that logistical aspects of deploying this streamer device well exceeded the requirement to deploy large numbers of hooks at an industry standard approaching every six seconds. The spider device did not function well with large fish (e.g. swordfish), which exceeded the entangling length of the filaments. The spider did outperform (logistically and as a depredation mitigation device) a sock-type physical protection cover that enclosed the hooked fish.

Rabearisoa et al. (2010) are further extending this work with enhanced visually reflective devices. Improving the streamer deployment mechanism is also a priority.

The streamer systems of Guinet (2007), McPherson et al. (2008), Rabearisoa et al. (2009) and Rabearisoa et al. (2010) are based on simple materials that the fishing industry could construct themselves. The approaches were specifically designed to provide industry with an example of how the passive sonar and mechanical approaches could best be applied by industry on a local or *ad hoc* basis. Toothed whales use a combination of sonar and vision during depredation events.

Nishida and McPherson (2010) used high target strength sonar materials (small air-filled spheres, McPherson et al. 2008) to develop a multiple streamer system (modelled with the help of United States and Australian defence-based sonar engineers) that would dominate sonar returns from tuna being attacked. The higher target strength returns were intended to highlight the fact that gear had actually entangled the tuna and interfered with the clarity of sonar returns to the toothed whale. The materials chosen in the streamer trials appeared to have a greater target strength than the probable target strength of the base of the brain case of tuna, where most false killer whales direct the primary attention of their initial depredation attack.

Trials of depredation mitigation streamers by Nishida and McPherson (2010) were conducted on Japanese High School fishery training vessels in high seas areas south of Hawaii, where depredation rates were very high during 2008. Trials were also conducted in Chinese fisheries and in Seychelles fisheries. Results again showed that deploying this simple system with the highest modelled target strength, though offering promise, did not warrant the effort required to deploy large numbers of the streamers where fish catch was often patchy.

Hawaii Longline Association fishermen have also trialled a variation of the passive acoustic streamer. Hawaii Longline Association vessels developed a system based on fine wire cable specifically designed to reduce bait depredation. Their results, based on 60,000 hook sets, found that fine wires did not mitigate bait depredation, and that higher target strength material was required.

Current conclusions for the passive acoustic streamer methods clearly indicate that the logistics for deployment (time taken to set and size the equipment) are not suited to high seas and large-scale longline activity. Cost would also be a factor where gear loss to sharks and lancetfish are high.

On more limited scales of longlining and trolling where depredation occurs, the technique offers more potential. The methodology has been particularly useful for troll fisheries where significant toothed whale depredation mitigation has been documented.

Passive sonar reflection is maximised when the wavelength of each incoming toothed whale species'

sonar system is matched with the dimensions and sonar reflectivity of the reflector. An added complication is that the highlighted sonar and hearing frequencies must consider the age of the whales as their hearing capability changes with age.

Additional high target strength materials for longline use have been identified, and these are better suited to the sonar of not only older toothed whales but for larger species such as killer whales.[3]

The role of toothed whale sonar systems in depredation

In order to better assess the type of fishing equipment that could be used to further enhance the passive acoustic interference approach, the Hawaii Longline Association will support a two-stage assessment of sonar target strengths of fishing gear and parts of tuna bodies.

The Hawaii Longline Associate will task a sonar engineer with theoretically modelling the target strengths of all gear components. Sonar engineers will then test the target strengths of components with exposure to false killer whale echolocation clicks. In that way, optimal reflector components will be determined as well as giving an indication of how to assess target strengths of any future gear components. Fishermen will be made aware of the materials with the highest passive reflection capability in order that industry can make its own passive acoustic reflector streamers that suit their own fishing conditions.

The work is due to take place in late 2010.

Dolphin dissuasive device acoustic pingers in depredation mitigation

Depredation of target species of gill nets and longlines by marine mammals has been well documented by the International Whaling Commission (IWC). In 1993, the IWC considered that depredation would become as much of a problem as bycatch in a few years, and that prediction has been confirmed.

Acoustic pingers[4] were developed to mitigate bycatch of porpoises, dolphins, whales and dugongs in gill net fisheries (McPherson et al 1999; Werner et al. 2006). Acoustic pingers are devices that generate a range of sounds, based on species and application, simply intended to alert inattentive marine mammals or those in turbid or low light conditions of the presence of the pinger and the net to which they are attached. Mammals with sonar capability such as dolphins are warned to enhance vigilance with their sonar systems to avoid entanglement. Mammals with passive acoustic listening capability such as whales, dugong and dolphins may detect the sound of the nets in the water on which the pingers are placed, or by an increasing sound field when an animal approaches a net with appropriately spaced pingers.

Acoustic pingers were developed in the mid 1980s to avert the massive world bycatch of marine mammals in gillnets. Currently they are obligatory in most US East and West coast offshore waters, and subject to a range of regulations in EU water. They are also used throughout Northeast Australia, South America and increasingly through parts of Asia, all areas where gillnet fishing is common. They are perhaps not well known in the South Pacific where gillnets are not as common.

Recent developments in pinger technology have established a capability for some pingers to specifically mitigate depredation of gillnet and line caught catches by toothed whales. The mechanism of this process is poorly known.

The Hawaii Institute of Marine Biology determined that a large pinger (made by SaveWave) reduced the echolocation capability and decision-making speed of false killer whales (Mooney et al. 2009). With time, the whales' echolocation performance increased to 85% on known targets under careful experimental conditions. The range at which this occurred was not suited to longline operations.

Nishida and McPherson (2010) tested a dolphin dissuasive device (DDD) acoustic pinger that was designed to dissuade toothed whale depredation from longline, trawl and purse-seine type gear. Paired vessel tests were conducted on Japanese High School vessels in the Pacific south of Hawaii over an eight-week period in early 2010. High depredation rates due to false killer whales have been reported from the areas assessed. Initial assessment is that the DDD pingers significantly reduced depredation rates in oceanic waters.

The DDD pinger is also being tested by fisheries in both the North and South Pacific, and the Indian Ocean where depredation is a major problem. Depredation by killer whales is being assessed.

An interactive DDD (DiD) pinger, triggered by echolocation clicks, has been developed by engineers at STM Products (Italy). The pinger is only activated by echolocation clicks of toothed whales. The type of pinger signal is constantly under review.

The interactive DiD pinger is currently being tested under longline fishery conditions by Japanese Fishery High School vessels in a high depredation fishery area in the central Pacific.[5]

[3] Fishermen interested in developing their own passive acoustic depredation mitigation methods for their specific circumstances, including toothed whale species, may contact Geoff McPherson at Engineering and Physical Sciences, James Cook University in North Queensland (geoff.mcpherson@jcu.edu.au).

[4] A pinger is a device used underwater to produce pulses of sound.

[5] For further information on these DiD pinger project, please contact Dr Tom Nishida (tnishida@affrc.go.jp) or Martin Ipuche at STM Products (martin.ipuche@stm-products.com).

Global detection systems depredation detector buoy

The fishing industry has long been aware that depredation behaviour is associated with active sonar activity and whistling behaviour. McPherson et al. (2008) demonstrated the sonar basis for depredation and the enhanced whistling behaviour of false killer whales during depredation events.

Whistles are exchanged between individuals as they share food during depredation events on fishing gear, including longlines. Whistles propagate equally in all directions from animals moving around their depredation targets. The distance of whistle propagation in oceanic conditions can only be modelled at this stage but it is of the order of distance spacing between longline radio or GPS locator buoys.

Hardware for the global detection systems buoy

Existing GPS buoys used in longline fisheries have the capability of sending narrow bandwidth signals considerable distances to receivers on vessels. Acoustic buoys with a mammal whistle wide, signal bandwidth usually reserved for marine mammal monitoring, cannot transmit long distances over water.

A prototype GDS buoy with two hydrophones.

The global detection systems (GDS) approach uses existing GPS buoy transmission systems to send existing position and water temperature information, as well as information relating to toothed whale whistling occurrences in the vicinity of longline gear (Clarke et al. 2007). Whistles in isolation and at high occurrences and intensity expressed within specific time periods are coded and transmitted to the receiver on the fishing vessel.

The GDS buoy will detect the close presence of depredation activity when it is positioned on a longline.

A special purpose hydrophone, developed with higher detection sensitivity than normal hydrophones, is able to detect whistles. Sonar or electrical engineers have spent a considerable time on longline vessels in the Coral Sea to develop this equipment and impart better gear "survival" rates. Information about the proximity of toothed whales will provide Fishing Masters with information that they can use to alter fishing strategy. Options include hauling sections of line where depredation has not occurred, or terminating setting when depredating whales are found to be following the vessel.

No decision has been made yet regarding the GPS-equipped range and direction finding buoy to which a hydrophone system and whale classifier and detector chip is to be added. Existing vessel signal transmission and receiver systems (GPS buoys) are considered to be cost-effective for the fishing industry. Existing receiver systems installed on vessels would be used.

Software for the GDS buoy

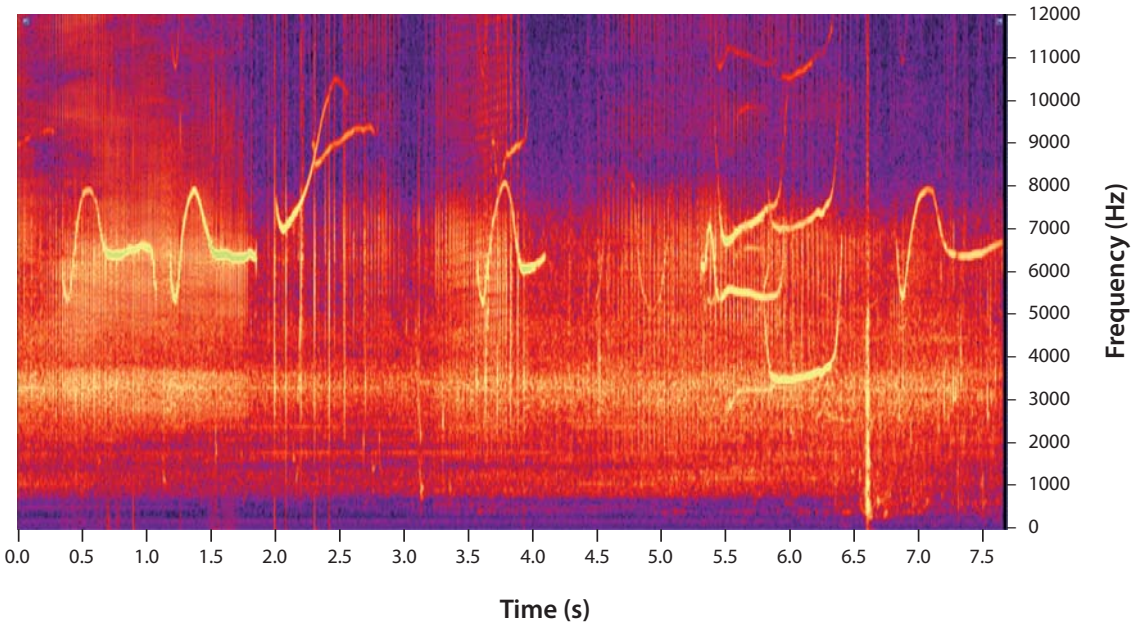
A whistle detection algorithm has been developed for this project in association with the School of Engineering and Physical Sciences at James Cook University in Townsville, Australia and JASCO Applied Sciences (also in Townsville), based on a process used to detect organisation within whale and dolphin calls, as well as structure in ancient languages and texts. The system has, to date, outperformed a range of automated energy detection systems for temperate cetacean species. The automated detection system has also outperformed experienced human observers.

A variety of toothed whale species are involved with bait and target fish depredation throughout the Indo-Pacific, each with varying acoustical signatures. Existing automated systems require detailed statistical information on the frequency and time features of whistles of each species. It is unlikely that these data would ever be available for the current application.

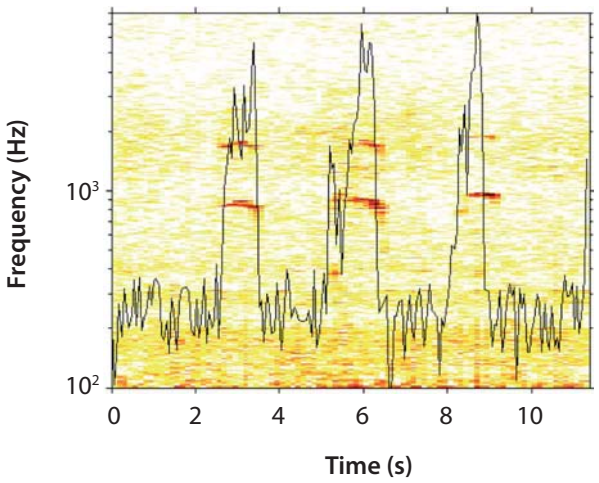
Whistle variation exists between individual depredation events by toothed whales and prey species. In one depredation event alone, 15 distinct whistle types were recorded. Isolated social whistles appear to have less variation, suggesting that whistles generated during depredation may have their own level of signal organisation.

The advantage of the GDS software is that it is not species specific. The GDS system would not experience problems associated with incomplete statistical datasets for whistles associated with toothed whale species. The software looks for patterns of organisation in the recordings permitting individual and group whistles to be detected.

Present longline position indicating buoys transmit a GPS location to the vessel via radio frequency. If a GDS buoy (and longline section) cannot be located by a vessel, GDS offers as an option a buoy localisation via satellite to a land station and then by email to the vessel.



Worse-case scenario spectrogram of a depredation event occurring next to a loud fishing vessel. A restricted number of false killer whale whistle types, broad frequency range echolocation clicks, overlap each other. The loud constant frequency noise from the vessel dominates the lower frequencies.



A spectrogram of beluga whistles enclosed within a line of entropy detection probability (Data provided by JASCO Applied Sciences). Detection occurs when the recording organisation probability exceeds a specified level.

Project status[6]

A broad range of whistles that are associated with bait and target fish depredation has been, and will be, sampled using a GDS developed acoustic recording ground truth buoy. This buoy has been developed to determine the total range of isolated and depredation-associated whistles from toothed whales over a range of open water and depredation-associated events. It is being used to determine the efficiency of the detection rate of the detector buoy. Sampling is about to begin in Australian and Hawaiian waters, and we would be pleased to hear from interested organisations in the South Pacific region.

A working prototype buoy for testing in Australian, Hawaiian and South Pacific waters will be ready before the end of 2010.

Summary

The depredation mitigation work summarised in this article is taken from a variety of projects that have been working in cooperation around the Indo-Pacific region since the early 2000s. Work is ongoing.

The methods are all seen as being mutually supportive. Some fishery sectors may find some methods more appropriate than others for their situation.

Acknowledgements

The authors would like to thank the funding and support of Japan's National Research Institute of Far Seas Fisheries (NRIFSF) and Fisheries Engineering, Australia's Fisheries Research and Development Corporation, Australia's Defence Science and Technology Organisation, Australia's AusIndustry and Commercialisation Australia, Italy's STM Products, Australia and Canada's JASCO Applied Sciences, USA sonar consulting firm RMC Acoustics and Engineering,

[6] For more information about the GDS buoy project, please contact Marketing (marketing@gds.com.au) or Geoff McPherson (mcpherson.geoff@gmail.com).

Hawaii Longline Association, Hawaii Institute of Marine Biology at the University of Hawaii, and the Western Pacific Regional Fishery Management Council.

The International Fishers Forum (IFF) series (Yokohama 2006, Puntarenas 2007 and Taipei 2010) provided an ideal opportunity to share depredation mitigation system methods with the Indo-Pacific fishing industry for the benefit of all, particularly passive acoustic entangling systems. We thank IFF organisers for supporting our attendance at these gatherings.

We also wish to thank the commercial fishery operators within the Indo-Pacific region (Japan, Hawaii, Seychelles and Australia) for their sharing of practical suggestions and honest appraisals of all our depredation mitigation versions. While we may make a variety of suggestions based on the acoustic capability of the toothed whales the definitive methods to reduce depredation will essentially come from the fishing industry.

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Original text: English

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