



Fisheries

Newsletter

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Editorial

Jean-Paul Gaudechoux will leave SPC at the end of June 2009, and has decided to let me drive the preparation of this first 2009 issue, a task he had assumed, with talent and obstinacy, for almost 20 years.

We open this issue with news from the various sections of SPC's Marine Resources Division. Reporting on all activities run by the Coastal and Oceanic Fisheries Programmes during this four-month period would require many more pages, more than you'd be ready to digest I'm sure. So, we have asked the Sections to concentrate on one or two key projects and their outputs, such as the impressive achievements of the Regional Tuna Tagging Programme, which has already tagged close to 200,000 tunas and skipjacks (p. 10), or the feasibility study of the development of tourist-oriented sport fishing activities in the Cook Islands (p. 14).

I hope you enjoy the articles in this issue. I welcome any feedback on them and encourage fisheries officers and managers from around the region to submit articles about any fisheries-related issues taking place in your country.

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SECRETARIAT OF THE PACIFIC COMMUNITY

Prepared by the Information Section of the Marine Resources Division and printed with financial assistance from France.

MARINE RESOURCES DIVISION

Tim Adams leaves SPC for a new challenge in Nauru

Dr Tim Adams left SPC in September 2008, after exactly 11 years at the helm of SPC's Marine Resources Division. He took up the post of Fisheries Management Adviser with Nauru's Fisheries and Marine Resources Authority, citing a need to "refresh his batteries by working at the national level again".

Born in northern England, Tim is a naturalised Scot and started his professional career with the Fiji Fisheries Division in the 1980s, learning the trade under such luminaries as Dr Peter Hunt, Ratu Tui Cavuilati and Dr Tony Lewis. During his time in Fiji he supervised the largest survey of giant clam stocks ever carried out, introduced the first limited-entry licencing regulations for the Fiji tuna fishery, and computerised the division's accounts, licencing and catch/effort-reporting systems.

He joined SPC in 1992 as Senior Inshore Fisheries Scientist and was later promoted to direct the newly-created SPC Marine Resources Division in 1997 by Dr Bob Dun. Working alongside, and then under, Bob's successors Lourdes Pangelinan and Dr Jimmie Rodgers, he oversaw a doubling of the Marine Resources Division's staff, a major increase in the number of Pacific islanders fisheries professionals, and campaigned for the addition of aquaculture advisory services, social science, and ecosystem science to the Division's portfolio.



Mike Batty, new Director of SPC Marine Resources Division



Mike Batty is already known to many fisheries people in the region as the former Development Policy Specialist with the Forum Fisheries Agency, and team leader of the EU-funded DevFish Project — a position he held for the last three years. He started work with SPC in December 2008.

Originally from Britain, Mike first came to work in the Pacific Islands in 1982 as Fisheries Adviser for the Government of Tuvalu. He then worked with the Solomon Islands Fisheries Department for two four-year contracts (with a break in-between for further studies). More recently, he managed Papua New Guinea's National Fisheries Authority during the reform of that agency, and has undertaken short-term work in Tonga and the Federated States of Micronesia.

Outside the region, Mike has also worked on fisheries projects in the South Atlantic and Red Sea, and developed an aquaculture research facility in Namibia. He is married with three children.

REEF FISHERIES OBSERVATORY

The EU-funded Pacific Regional Oceanic and Coastal Fisheries Development Programme (PROCFish/C) and the Coastal Fisheries Development Programme (CoFish) continued compiling and editing country reports as well as conducting some follow-up invertebrate surveys in Fiji.

The PROCFish/C project officially concluded on 28 February 2009, while the CoFish project continues until 31 December 2009, or until funding is exhausted. Any outstanding reports from the PROCFish/C project will be produced under CoFish to ensure that all objectives are fully met for both projects by the end of 2009.

PROCFish/C and CoFish team shrinks further

In late 2008 and early 2009, several staff left the project. Kim Friedman left in November 2008 after almost seven years with the project as Senior Fisheries Scientist (invertebrates). Kim accepted a position as Principal Research Scientist with the Western Australian Department of Environment and Conservation's Marine Science Programme. While working in his new position, Kim has also been assisting the remain-

ing PROCFish invertebrate team members with finalising several project reports.

Sarah Langi, who was recruited to edit country reports, left at the end of her contract in December 2008. Sarah made good progress during her time with the project, and has been hired as a consultant to edit the remaining country reports as they are compiled and formatted.

Pierre Boblin who was a Reef Fisheries Officer (finfish) with the project for almost four years left at the end of February 2009. Pierre is now working as a freelance consultant in New Caledonia, conducting underwater visual census surveys and other activities. The project will miss Kim, Sarah and Pierre, and wishes them well with their future employment.



From left to right: Kim Friedman, Sarah Langi and Pierre Boblin.

Status of country reports

Reports for Niue, Kiribati, Samoa, and Wallis and Futuna were published earlier this year, with a French version of the Wallis and Futuna report produced as well. After each country report is published it is placed on PROCFish/C's web portal on the country specific page. The report for Papua New Guinea

is ready for publishing and the one for French Polynesia is being translated. Three other reports are with countries for comment and clearance (Solomon Islands, New Caledonia and Palau). The remaining five country reports will be finalised over the coming months and will be published before the end of 2009.

The remaining scientific staff will focus on analysing data and producing a regional assessment that will try to identify indicators of reef fishery status. This is a work in progress, which will also include the writing of several scientific publications based on the results of this analysis.

Invertebrate resource surveys in Fiji Islands

Invertebrate field work was conducted at four sites in Fiji Islands in February 2009. The sites of Mali and Lakeba in Vanua Levu and Dromuna and Muaivuso in Viti Levu were assessed in 2003 but were re-surveyed in 2009 using refined tools and survey methodologies developed by the PROCFish/C and CoFish projects.

This re-survey also provides a picture of resource status trends over the six years between surveys. The four-week survey was headed by Kalo Pakoa from the project's invertebrate team, with assistance from Fiji's Fisheries Research Officers, Babitu Rarawa, Peni Drodrolagi and Serugali Ledua, and Hans Karl Wendt, a post-graduate student from the University of the South Pacific (USP). The project acknowledges the assistance of Fiji's Fisheries Division and staff Sunia Waqainabete, Aisake Bati-basaga, Aminio Raumuria, and Joji Vuakaca; as well as John, Sahh, Jone and Tavenisa for their support in Labasa; and in Suva, the Macuata Province Administration for its logistical support. Special thanks are also given to Bill Albersberg and Ron Vave from USP's Institute of Applied Sciences for their advice, and for allowing Hans to join the team; and to the village chiefs and

their communities at Muaivuso, Dromuna, Mali and Lakeba.

MALI ISLAND

Mali lies off the Labasa mainland. The reef is part of the Great Sea Reef (Cakau Levu) stretching across the entire northern coast of Vanua Levu Island (Fig. 1). The middle part of the reef system, known as Vuata Reef, is separated from the outer barrier by a shallow "pseudo" lagoon system. Thin mangrove forest cover parts of the island.

While extensive, most of the shallow areas are predominantly sandy. The main seagrass bed is found in the middle section of the Vuata reef flat, about half of which is within a marine protected area (MPA) that was established some years ago. This MPA allows for village membership to the Fiji Locally Managed Marine Area (FLMMA) group — a network of community conservation interests. The MPA is about to be extended to the Vorovoro Passage fish spawning site reserve. The present survey was careful not to go over the Mali's boundary (like the first surveys did) and paid more attention to the MPA for impact assessment purposes, which was requested by both Macuata Province and the FLMMA group.

Survey coverage during the present survey was better. Sea cucumber diversity was incomplete, with the same 11 out of 19 commercial species recorded. None of these species showed any marked improvement in abundance between the two survey periods, and three species (*Actinopyga mauritiana*, *A. miliaris* and *Holothuria scabra*) previously known in the area, were absent in both of the surveys, suggesting they may have been extirpated. *A. miliaris* was reported to be common in a resource survey conducted 20 years ago. A slight improvement was seen in the MPA for *Stichopus chloronotus*, *S. hermanni*, *Holothuria atra* and *Bohadschia argus*, which is promising, although others such as *H. fuscogilva* still appear to be overharvested. Sea cucumbers can be sold raw directly to processors in Labasa. Increasing the MPA outwards to the outer barrier reef is recommended. Overall, Mali's sea cucumber resources are very much depleted, and any form of fishing activity should be discouraged.

The only two giant clams, *Tridacna maxima* and *T. squamosa*, were present in dangerously low numbers. The number of *T. squamosa* was slightly higher than for *T. maxima* because the former was protected within the MPA, while much of the suitable *T. maxima* habitat is widely accessible.

Similarly, a small population of *Trochus niloticus* in the reef passages is currently protected, with very few shells found on the outer slopes of the barrier reef despite the presence of suitable reefs. *Trochus* numbers have not changed since the last survey, suggesting unsuccessful breeding, which happens when spawners are scattered apart for successful fertilisation.



Figure 1. Survey coverage – Mali, Vanua Levu.

LAKEBA (VANUA LEVU)

Lakeba village is one of several villages and settlements in Namuka District that share the same fishing zone (Fig. 2). The reef is extensive, with diverse habitats such as a well developed mangrove system, a large area of seagrass beds, shallow and deep lagoons, back-reefs and an outer reef slope. However, as in Mali, the lagoons are predominantly sandy-bottomed with scattered hard-bottom formations.

Lakeba joined the FLMMA group in 2003 when it established an MPA on Cakaunikuita Reef, the inner reef flat in front of the village. *Actinopyga miliaris* was one of the main marine products in the area and one of the principal resources requiring protection. In 2007, the MPA closure was lifted, and *A. miliaris* was the main species harvested (in boat loads) and sold raw to a Chinese buyer in Labasa for FJD 6.00/kg whole (Seruqali Ledua, Fiji Fisheries Division, pers. comm., 2009). Because the MPA was abandoned until just before the team's arrival, the village decided to reactivate it.

Sea cucumber diversity was intact, with 17 species recorded, the same as in the first assessment. However, *Actinopyga miliaris* was not recorded during this survey, although it was present in good numbers in the first survey. *Holothuria fuscogilva* was present but sporadic in the sandy lagoon along back-reefs, and *H. scabra* is in danger of being extirpated (only one specimen was found in an open access area). Sandfish is a local delicacy in Fiji. The *Stichopus horrens* population — locally known as “caterpillar” — seemed to be healthy, although it is not typically exploited due to its very small size. Sea cucumber harvesting was very active in Lakeba compared with all other sites, with products sold raw, partly cooked or fully dried to processors in Labasa. Lollyfish (*Holothuria atra*) make up the



Figure 3. Boiled lollyfish, the main sea cucumber processed in Lakeba.

bulk of fishers' catch (Fig. 3) followed by greenfish (*Stichopus chloronotus*) and pinkfish (*H. edulis*). *H. atra* is ranked the lowest in value, and its dominance in catch composition is a significant indicator for over-exploitation in the fishery.

The giant clam *Tridacna maxima* was more common than *T. squamosa*, but densities were as low as at other sites. Active breeding is occurring, but considering the less favourable environments around Lakeba, stronger management efforts should be pursued by the community.

A small population of *Trochus niloticus* is found north of the main passage. *Trochus* harvests in 2007 amount to 300 kg, which sold for FJD 1,500 (at FJD 5.00/kg). The community should consider protecting the existing stock. Populations of the clam, kaikoso (*Anadara* spp.), were found at all four sites. Perhaps moderate harvesting is one contributing factor. However, it would be wise to develop a management plan that would help sustain the resource over a longer term, especially while the stock is still in good condition. Management of the Lakeba MPA is of concern. More advice is needed and an MPA management plan may provide guidance.



Figure 2. Survey coverage – Lakeba, Vanua Levu.

DROMUNA, VITI LAVU

Dromuna is one of two villages at Kaba Point, both of which share the same fishing area (Fig. 4). Kaba's lagoonal reefs are extensive and complex, having all of the qualities for supporting a diverse array of species. Coral cover on the reef slope north of the main passage was healthy, with 60–70% coverage in some places. Dromuna does not have an MPA; the village elders prefer that their reef remains open to access, to support the daily food security needs of their people.

Sea cucumber diversity in Dromuna was intact with 17 species recorded. This is in contrast to the first survey which recorded 12 species. A global decline in density was revealed between the two periods, which can be linked to fishing pressure. Only two white teatfish specimens (*Holothuria fuscogilva*) were recorded from the passage area. Divers fished these lagoons using scuba and hookah gear, which may have contributed to the scarcity of the resource. Many shallow water species, including *Bohadschia argus*, *B. vitiensis*, *Stichopus chloronotus*,

S. hermanni, *Holothuria atra* and *Thelenotas ananas* were present, although continuous exploitation has kept their populations from increasing. Sandfish (*H. scabra*) is represented by a few juveniles and is no longer harvested. *H. scabra* was the third most common product in fishers' catch in 2003. The blackfish, *A. miliaris*, was recorded only in Dromuna but the numbers recorded and those noted in fishers' catches indicate a large decline since 2003. In total, 4,202 specimens were recorded in fishers' catches in 2003, while half of a bucket load was seen on one occasion in 2009. *A. miliaris* is collected at night and sold raw to a processor in Nakelo Landing at FJD 5.00/kg for large specimens, and FJD 4.00/kg for smaller specimens.

The same situation exists for the giant clams *Tridacna maxima* and *T. squamosa*: their numbers are low and sporadic, with few large-sized individuals noted. *T. niloticus* is survived by a small population distributed on the outer barrier reefs and passages. A dramatic decline in the density of *Anadara* spp. was noted in 2009.



Figure 4. Survey coverage for Dromuna, Kaba Point, Viti Levu.

MUAIVUSO, VITI LAVU

Muaivuso Reef is a much smaller study area (Fig. 5). The available reef is shallow with the outer reef flat is exposed at low tide, with a few "blue holes" (pools) in the middle of the reef. The outer barrier reef is less well developed and drops steeply from the reef crest. Over 60% of the reef is protected by an MPA initiated in 2001 and covering the middle area out to the reef edge (Fig. 5). Muai-vuso's eastern reef is exposed to pollution such as siltation and solid wastes from Suva city.

Sea cucumber diversity was low, with 12 species recorded. Three important species *Actinopyga miliaris*, *A. echinites* and *Holothuria fuscopunctata*, which were documented in 2003, were absent in the 2009 surveys. This is surprising because both *A. miliaris* and *A. echinites* numbers in the 2003 survey — just five years ago — were high. Both species can be easily overharvested because they are found in accessible shallow-water areas. All three sea cucumbers may not come back. *H. scabra* and *H. scabra versicolor* were represented by one specimen each, the latter being the only specimen documented in all of the Fiji sites. Both species deserve maximum protection if they are to survive at all. *H. atra*, *H. edulis*, *H. nobilis*, *Stichopus chloronotus*, *S. hermanni* and *Bohadschia argus*



Figure 5. Survey coverage for Muaivuso, Suva, Viti Levu.

improved in densities within the MPA in contrast to open access reefs. The positive effect of the MPA is encouraging, although overall, the resource has not improved and three species may have been extirpated and two other will follow if adequate protection is not provided.

No improvement was seen for the giant clams, *Tridacna maxima* and *T. squamosa*, although notable numbers seem to have been preserved inside the MPA. Similarly, for *Trochus niloticus*, overall numbers were higher in 2003 than in 2009, but notable stocks are protected inside the MPA area, and can repopulate. Muai-vuso is known for its collector urchin (*Tripneustes gratilla*), which is the main edible sea urchin sold at the Suva market. A drop in density was noted overall since 2003, but again the MPA seems to have preserved a good population. A small population of coral-eating crown-of-thorns

starfish (*Acanthaster planci*) has eaten away much of the corals at Nukusanga Passage.

TRAINING

On-the-job training of three participants — Peni Drodrolagi, Babitu Rarawa and Hans Karl Wendt — was successful

(Fig. 6). Their participation enabled them to acquire basic skills in species identification, using different invertebrate surveying techniques, recording data, using GPS, habitat identification and placing stations, safety issues in underwater assessment work, and planning surveys.



Figure 6. Survey team. From left to right: Kalo Pakoa, Babitu Rarawa, Peni Drodrolagi and Hans Karl Wendt.

The 11th Pacific Science Inter-Congress

The 11th Pacific Science Inter-Congress — held in conjunction with the 2nd Symposium on French Research in the Pacific — took place from 2–6 March 2009 in Tahiti, French Polynesia. The conference was organised by France and French Polynesia in association with the Pacific Science Association. SPC's PROCFish/C programme was

represented by Mecki Kronen, Community Fisheries Scientist, who gave a short presentation and poster on "Assessment of finfish fishing pressure (and risk) and identification of major socioeconomic and resource (biology and habitat) drivers".

About 1,000 participants from the Pacific, France and else-

where attended the conference. There were five parallel sessions: "Ecosystems, biodiversity and sustainable development", "Climatic change and ocean acidification", "Public health challenges in the Pacific", "Culture and politics", and "Governance and economy".

Sixth and final Advisory Committee meeting for PROCFish

The sixth and final Advisory Committee meeting for PROCFish/C (EDF8, ACP and OCT) and CoFish (EDF9, ACP) was held in Noumea, New Caledonia on 9 February 2009. The meeting brought together representatives from 14 of the 17 participating countries, the EC Delegation in Suva, the Regional Authorising Officer (Forum Secretariat) in Suva, and a range of observers from the US territo-

ries and other regional organisations and NGOs.

The meeting was divided into four sessions or themes.

SESSIONS 1: Update on project activities and outputs

Project Manager, Lindsay Chapman, reported to the Advisory Committee on project objectives and progress, stating that all

outputs will be fully completed in the remaining time of the two projects, with PROCFish/C concluding on 28 February 2009, and CoFish to conclude on 31 December 2009. Over 175 Pacific Island nationals received training through in-country activities during fieldwork or regional or sub-regional workshops. Seven country reports were published and in the public domain, with four others to

be finalised in the first quarter. The remaining six reports will be compiled, edited and with countries for comment and clearance by the middle of 2009. The report of the regional comparative assessment will also be drafted by mid-2009.

There was considerable comment by the Advisory Committee on the project, with many countries expressing disappointment at the length of time to receive survey results and country reports, although countries were pleased that the reports were beginning to come out. There was also strong support for further, similar survey work to be undertaken in some countries, especially the larger ones, with results to come out in a more timely fashion.

Countries were also pleased with the training that was provided, although further training would be required due to staff turnover within countries. Areas highlighted for future work were the need for monitoring programmes to be developed and implemented at the national level, as well as further assistance with survey work on specific species rather than general surveys. In reply, the Project Manager stated that these areas were built into an EDF10 funding proposal; however, if successful, the funding would not be available until early to mid-2010.

SESSION 2: Data acquisition, scope and mechanisms for its distribution, and characteristics and variations of fisheries communities and their resource

The project's Information Manager, Franck Magron, presented the data acquired, its scope, and the mechanisms for its distribution. Mecki Kronen, Community Fisheries Scientist, gave a presentation on the socioeconomics of fisheries communities, Silvia Pinca, Senior Fisheries Scientist (finfish), discussed the diversity of finfish resources, and Kim Friedman, former Senior Fisheries Scientist (invertebrates) discussed the characteristics of invertebrate communities. Countries expressed interest in the database and the possibility of adding additional data collected by countries, as well as the need for country staff to be trained in analysing and presenting data.

SESSION 3: Fishing pressure, variation in fish and invertebrate resources, and the current database and software

Mecki Kronen gave a presentation on fishing pressure (finfish and invertebrates), Sylvia Pinca discussed the variation of fish resources due to use, Kim Friedman presented the status of key invertebrate stocks, and Franck Magron presented the

current databases and software, and future developments to these. There was interest in the indicators or density levels for invertebrates, especially some beche-de-mer species. In regard to the database, countries were supportive of further development to incorporate other data, especially data direct from the private sector, which would be summarised and provided to fisheries departments. The issue of data confidentiality was raised, and participants were assured that the data belonged to each country, and that SPC would not release this information to third parties without country permission.

SESSION 4: Recommendations for fisheries management and monitoring of resource changes due to use in view of climate change and consequences for livelihoods

Mecki Kronen presented the use of decision tools and price mechanisms, Sylvia Pinca presented information on finfish resource monitoring, and Kim Friedman presented information on managing key invertebrate stocks. There was some discussion on management, especially in regard to spearfishing, with the use of scuba and lights at night highlighted as bad practices that should be banned. Other important topics that were discussed include the need for a range of surveys in the future (in-water, socioeconomic, marketing data, etc.), and the need for awareness and educational materials on survey methodologies, with the suggestion that a CD/DVD be produced on how to conduct underwater visual censuses. A CD/DVD would allow in-country fisheries staff to learn these techniques on their own, especially where in countries with a high turnover rate of staff. In reply, more specific recommendations were offered for easier and quicker surveys for the three disciplines.



Graham Nimoho, from Vanuatu, and Dr Chris Ramofafia, from the Solomon Islands, were among the meeting participants.

Activities of the Live Reef Fish Trade Initiative

A proposed draft of a management policy was previously prepared by SPC's Senior Fisheries Scientist (Live Reef Fisheries), Being Yeeting, and provided to the Marshall Islands Marine Resources Authority (MIMRA) for comment. In February 2009, MIMRA sent in their comments, with a request that the Senior Fisheries Scientist look over the document again before finalising it. The policy document will eventually be finalised by the Management Board and then submitted to Marshall Islands government for endorsement.

COMPLETION OF THE UPOLU MARINE AQUARIUM TRADE RESOURCES SURVEY REPORT

Following the attachment training of a fisheries officer from Samoa in late 2008, the Upolu Marine Aquarium Trade Resources survey report was finalised. The report indicates that marine aquarium fish resources around Upolu Island are abundant enough to support some marine aquarium fish operations. The report recommends that if Samoa decides to restart such operations, then they should also look at economic feasibility and develop the best possible marketing strategies. Before allowing any operations to start, management policies, a management plan and regulations should be developed. With completion of the report, the decision now remains with the Samoan government to decide whether it wants to revive the marine aquarium fish industry in Samoa or keep it closed.

COMPLETION OF ENFORCEMENT GUIDELINES ON ILLEGAL REEF FISHING FOR THE AUSTRALIAN PACIFIC PATROL PROGRAM

In early 2008, a letter was received from the Australian Defense Force Pacific Patrol Boat Programme requesting SPC's

assistance and collaboration in developing enforcement guidelines for illegal reef fishing activities. Such guidelines would help the crew of patrol boats to be better recognise and enforce against illegal reef fishing activities in the Pacific. Given the significance of illegal fishing activities — especially in the live reef fish trade (e.g. cyanide fishing and use of other chemicals such as bleach, MS-222, clove oil and terrin), and poaching of protected valuable species (e.g. humphead wrasse) — SPC's Live Reef Fish Section was given the responsibility of assisting the Australian Defense Force.

In early 2009, after considerable discussions with Australian Defense Force counterparts, the final draft of the Enforcement Guidelines was completed.

DEVELOPMENT OF THE LIVE REEF FISHERIES MONITORING DATABASE

To save money and time, the PROCFish Database Manager, Franck Magron, is working on this project. The advantage being that once it is developed, the database can be used as the basis for setting up similar databases for monitoring other reef fisheries. Following initial discussions and the information collected from countries in late 2008, a proposed database structure, showing the flow of information, was developed. Details of the information and data to be collected, including data forms, were then developed and incorporated into the database design.

A document describing the proposed architecture of the database was prepared and was sent to participating countries for comments. The purpose of this is to ensure that the system on which the database would be developed is compatible to what exists in the countries.

Work on the database will continue through 2009, with the hope of getting the first version out for trial before the end of the year. A hands-on training workshop to explain the database and show how it works will be held for the three countries involved in the pilot project. Following this workshop will be an in-country implementation of the database with technical support and advice to be provided as needed by SPC.

THE PACIFIC REGIONAL CIGUATERA INITIATIVE RECEIVES ENDORSEMENT OF HOF6

During the 6th Head of Fisheries (HOF) meeting — held at SPC's headquarters in Noumea, New Caledonia from 9–13 February 2009 — the Live Reef Specialist presented the outcomes of a ciguatera workshop in late 2008 on behalf of the Ciguatera Conference Steering Committee. The presentation highlighted the increasing threat of ciguatera fish poisoning to food security and income earning opportunities to PICTs, especially in small atoll countries that lack agricultural resources and depend entirely on their marine resources for their livelihoods. Recommendations from the ciguatera conference to set up a Pacific Regional Ciguatera Initiative to help PICTs address ciguatera fish poisoning and other related marine biotoxin problems was also presented to HOF participants for their support and endorsement.

IUCN WRASSE AND BLENNIES RED-LISTING WORKSHOP

The red-listing of fish species is a process developed by the International Union for the Conservation of Nature to check on the status of exploited fish species and to assess and classify species according to their respective level of global risk

for extinction. Critically endangered species eventually become listed by the Convention on the International Trade in Endangered Species (CITES), which provides some protection for trade through the implementation of the convention by party countries.

As a member of the Groupers and Wrasse Specialist Group, and with experience with the assessment process, SPC's Live Reef Specialist was invited as one of the regional experts to assist in assessing two particular groups of fish: wrasses and blennies. These two fish groups are very important to the marine aquarium trade in the Pacific, and a review showing the status of those fish species was presented by the Live Reef Specialist. The assessment was made to ensure that fish species are not red-listed unnecessarily, based on their status from other parts of the world.

The workshop ran from 23–28 March 2009 in the Philippines. Attending the workshop were 12 global labrid and 3 global blenny experts, 11 participants from the Coral Triangle Initiative participating countries (Malaysia, Indonesia and the Philippines), and some participants from Silliman University, the local university in Dumaguete.

In total, 255 wrasse species were assessed, with most of them rated as "Least Concerned", meaning that they are quite abundant throughout their range and are not currently being threatened by exploitation. About 44 species were listed as "Data Deficient", meaning that there was not enough information to assess the species. Usually these are species where information regarding them is based on a single specimen. No species were considered as endangered although one species from the Persian Gulf, *Halichoeres leptotaenia*, was listed as "Near Threatened" because the species is naturally rare with a very limited geographical range and is being heavily targeted. For the Pacific region, no species of blennies or small labrids are of concern.

MEETING WITH THE SOCIETY FOR THE CONSERVATION OF REEF FISH AGGREGATIONS

Being Yeeting met with Yvonne Sadovy, chair of the Society for the Conservation of Reef Fish Aggregations (SCRFA), to determine whether there were any new issues emerging in regard to managing and monitoring reef fish spawning aggregations. A common request coming from member countries is the need for assistance and training in how to monitor and manage reef fish

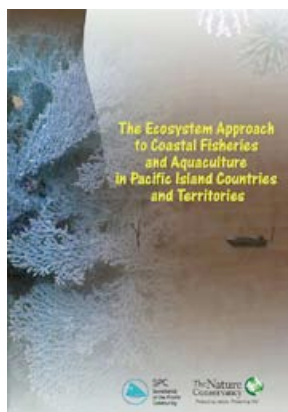
spawning aggregations. Countries that have expressed this interest include Cook Islands, Kiribati, Marshall Islands, Samoa and Vanuatu. It was agreed that a hands-on field training workshop on monitoring methods would address this need.

Funding for the workshop has been secured through the Coral Reef Initiative for the South Pacific (CRISP) project, with the workshop is scheduled for late August 2009. CRISP has agreed to provide airfares and per diem for two participants from each of the five countries. Plans are now being made with Fiji's Fisheries Division and SCRFA to prepare for the workshop.

PREPARATION OF AN UPDATED CIGUATERA POSTER FOR PUBLIC AWARENESS

In support of ciguatera awareness, an updated poster has been prepared in collaboration with the French Institute for Research and Development. The poster incorporates some of the new information, especially new findings and research on cyanobacteria as a possible cause of a slightly different kind of fish poisoning, mainly from the consumption of molluscs (bivalves) such as giant clams. The poster has been printed and translated into Bislama for a planned field trip to Vanuatu.

New booklet published: "Ecosystem approach to fisheries and aquaculture in PICTs"



The ecosystem approach to fisheries (EAF) is an improved approach to developing and managing coastal fisheries and aquaculture. It takes into account the broader effects of fishing on the environment, as well as the effects of other sectors on fisheries and the ecosystems within which they occur.

This 20-page booklet, prepared by Garry Preston, from Gillett, Preston and Associates, and co-produced by SPC and The Nature Conservancy, gives a brief overview of EAF guiding principles and how they could be applied in the Pacific Islands region.

PDF copies can be downloaded from:

http://www.spc.int/coastfish/Reports/EAFM_Workshop/EAFM_Booklet.pdf

For hard copies, please contact: Fisheries Information Section, SPC, BP D5, 98848 Noumea Cedex, New Caledonia. Email: cfpinfo@spc.int



REGIONAL TUNA TAGGING PROGRAMME

Nearly 200,000 fish tagged

Tuna fisheries provide an important source of income for many Pacific Island countries and territories; therefore, obtaining high-quality scientific information on the sustainability of tuna stocks is critical for ensuring the long-term future of and the economic benefits derived from them.

Tuna tagging provides information on the movements, growth and mortality rates of tuna. The Pacific Tuna Tagging Program (PTTP), which is implemented by SPC's Oceanic Fisheries Programme (OFP), collects this information from equatorial regions of the western and central Pacific Ocean. OFP then uses this information to improve the accuracy and quality of stock assessments for its member countries.

Tuna tagging involves capturing live fish (Fig. 1), attaching a small, but visible tag to them, measuring their length, and releasing them back into the ocean. The fish are tagged and released within a few seconds of capture. Since the start of the tagging programme in 2006,

over 194,000 skipjack, bigeye and yellowfin tunas have been tagged and released. According to observed trends, over 200,000 tunas are expected to be tagged and released by mid-July 2009. Concurrently, the project has tagged tunas using two types of electronic tags — acoustic transmitting tags and archival storage tags — and over 600 fish have been released with these tags.

The project has so far used three vessels to tag fish. The pole-and-line vessel *Soltai 6*, which has limited range, has been used to tag tuna in waters of Papua New Guinea and Solomon Islands. *Soltai 105* is a long-range range pole-and-line vessel and has been used for extended tagging cruises in the exclusive economic zone (EEZs) of the Federated States of Micronesia, Kiribati, Indonesia, Marshall Islands, Palau, Philippines, Tuvalu and the high seas. The *DoubleD* is a handline vessel chartered from Hawaii and has been used to tag tuna in the central Pacific, in

the Line Islands region of Kiribati, and in the equatorial high seas areas bordering French Polynesia north of the Marquesas Islands. Figure 2 shows the area currently covered by the PTTP and Table 1 indicates the number of fish tagged per EEZ.

As of 31 April 2009, more than 22,000 tags have been recovered and returned to SPC (Table 2). Most of these fish were tagged with yellow plastic dart tags bearing the serial numbers of the tag and the words "SPC NOUMEA – REWARD – www.spc.int/tagging".

The *Soltai 105* is expected to complete its current cruise in mid-June 2009 and will begin its next cruise in mid-July 2009 which will concentrate on tagging fish in the high seas pocket between the Federated States of Micronesia, Indonesia, Palau, Solomon Islands and Papua New Guinea, as well in each of these countries' EEZs. The *DoubleD* is also expected to complete its current cruise in July and will



Figure 1. Triple poling a large bigeye tuna on *Soltai 105*.

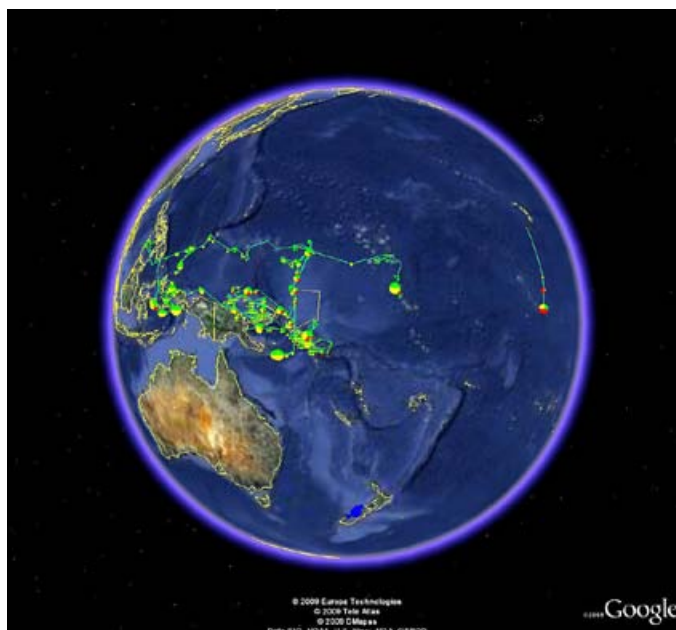


Figure 2. Western and central Pacific tag releases (Google Maps).

Table 1. Tag releases by exclusive economic zone (EEZ) as of 30 April 2009.

EEZ	Tag releases
Federated States of Micronesia	11,730
Indonesia	25,197
Kiribati (Gilbert Islands)	12,783
Kiribati (Line Islands)	1,959
Marshall Islands	1,312
Palau	7,289
Philippines	1,914
Papua New Guinea	82,153
Solomon Islands	41,323
Total	185,660

Table 2. Tag releases and recoveries as of 30 April 2009.

Species	No. of releases	No. of recoveries	%
Skipjack	116,922	13,849	11.28%
Yellowfin	63,952	7,709	11.87%
Bigeye	4,786	967	14.61%
Total	185,660	22,525	11.59%

depart for its next cruise in October 2009, concentrating its efforts along the tropical atmosphere ocean (TAO) buoys in the central Pacific Ocean.

TAG RECOVERY

It is very important for the success of the project that all tag recaptures be reported to SPC. Therefore, PTPP staff ask commercial and recreational fisherman to be on the lookout for tagged fish among your catch. If you find one, we ask that you record the following information:

- Tag number
- Species
- Capture date
- Capture location (degrees and minutes of latitude and longitude)
- Fish length (measured on a flat surface from the tip of the head to the fork in the tail)
- Set type (e.g. drifting FAD, anchored FAD, log, free school)
- Vessel name
- Finder name and address, including email address

Once you have recorded this information, the tag should be removed from the fish and stapled or taped to the paper on which you recorded the data.

Tags can be redeemed for cash rewards (10 US dollars for each conventional plastic tag) or a PTPP polo shirt. A small number of tunas have an electronic archival tag implanted into their body cavity (Fig. 3). A sensor stalk can be seen protruding from the body of the fish. Most of these fish have also been

tagged with a red conventional tag. Please **carefully** remove the archival tag from the fish and keep it with the accompanying plastic tag and data as described above. SPC will pay a reward of USD 250 for an archival tag in addition to USD 10 for any conventional tag.

SPC maintains a website for the PTPP where tags can be reported and where further information about the tagging programme can be found. The website address is www.spc.int/tagging/. Tag returns and recapture information can also be reported to tagging@spc.int.

Upon return to port, please post tags and accompanying information to:

Helene Ixeco
Oceanic Fisheries Programme
SPC, BP D5
98848 Noumea Cedex
New Caledonia

or give them to your local fisheries office.

BIOLOGICAL SAMPLING

The tagging cruises have been exceptional opportunities to conduct biological sampling, which complements the work undertaken by national observers of many countries in the region who contribute to SPC's trophic tuna studies.



Figure 3. Electronic tag being surgically implanted by "master-tagger" David Itano.

Observers collect stomach, muscle and liver samples of tuna and other pelagic fish species while observing onboard purse seiners and longliners. Collecting these samples constitutes the foundation of our pelagic ecosystem descriptive work. Examining stomach contents and chemically analysing muscle and liver samples enables us to describe the diet of different species and determine the relationships between these species. These data are included into ecosystem models, which then help us understand how the ecosystem functions by simulating the impact of fisheries management measures and environmental changes.

The tagging project has allowed us to collect additional samples from areas that have already been sampled (e.g. Papua New Guinea, Solomon Islands and

Federated States of Micronesia), and has provided an opportunity for us to collect samples in areas where fish have not previously been sampled or were only poorly sampled such as Palau or Kiribati (Fig. 4)

Since the beginning of the PTTP in 2006, the scientific team onboard *Soltai 105* has collected 3,618 stomach, muscle and liver samples (Fig. 5). Most of the fish sampled were skipjack (*Katsuwonus pelamis*) (1,796) and yellowfin (*Thunnus albacares*) (1,504), although we also collected bigeye (*T. obesus*) (140) and 178 specimens of various species such as marlin, rainbow runner (*Elagatis bipinnulata*), kawakawa (*Euthynnus affinis*) and mahi mahi (*Coryphaena hippurus*).

Moreover, we have been using a new electronic device called

the “fatmeter”, which allows us to test the fat content of fish using microwave technology that does not require chemical analysis (Fig. 6). The fat content gives us another source of information on the diet and health status of the fish, and complements the more classical stomach content examination and chemical analysis approach. This device has enabled us to test 2,277 fish so far, including 79 bigeye, 1,270 skipjack and 928 yellowfin.

Stomach content examination began in 2006 and is undertaken at SPC (Noumea) in OFP’s laboratory. In total, 1,156 stomachs have been examined, including 36 bigeye, 638 skipjack, 409 yellowfin and 73 specimens of other species. Collection and examination of stomach samples is ongoing.



Figure 4.

Thomas Usu (Papua New Guinea) conducting onboard biological sampling.



Figure 5.

Large yellowfin tuna stomach sample showing a whole skipjack recently eaten.

Figure 6. Digital fat meter reading.

■ NEARSHORE FISHERIES DEVELOPMENT AND TRAINING SECTION

Feasibility study of sport fishing development in Cook Islands

A feasibility study on developing a sport fishing enterprise in Rarotonga and Aitutaki was undertaken by SPC's Nearshore Fisheries Development and Training Section in response to a technical assistance request from the Cook Islands Ministry of Marine Resources (MMR). Consultant Etienne Picquel, accompanied by SPC's Nearshore Fisheries Development and Training Adviser, Michel Blanc, travelled to Cook Islands for two weeks from 14–27 April 2009. Logistical support (travel, boats, meetings with local people) was organised by MMR on Rarotonga and Aitutaki.

The fishery resource observed during fishing trips (5 trips on Rarotonga and 11 on Aitutaki), the state of the tourism infrastructure (including hotels), and the commitment to development expressed by all political leaders and fishery officers and operators, offer promising prospects for the diversification (in Rarotonga) and development (on Aitutaki) of sustainable sport fishing in Cook Islands.

A number of suggestions and a budgeted action plan, including relevant training activities and resource management prospects, have been put forward. Technical and financial support for local fishing guides will be required initially until this sector becomes operational on a self-supporting basis. The sustainable establishment of the sport fishing sector in Cook Islands will be made easier if active cooperation between fishers, MMR, the Cook Islands Tourism Corporation, and local governments takes place as early as possible as part of the development process.

The suggested action plan revolves around diversify-

ing sport fishing activities on Rarotonga and developing a number of activities on Aitutaki, including fly fishing for bonefish. This highly specialised activity, with its potential for generating considerable income and creating jobs, will require a resource assessment, a management plan, and some specific marketing work.

The potential for developing sport fishing destinations appears strong in the Pacific. While the presence of fish is obviously an important factor, there are other key prerequisites to establishing sport fishing operations. International and domestic transport to fishing grounds, suitable (and if possible) varied accommodation, safe and comfortable boats, and skilled and trained fishing guides need to be in place before any sport fishing destination can be promoted overseas. Sport fishing is already practised in a number of Pacific Island countries and territories but existing charters are

primarily for big game fishing trips out of urban centres. Other sport fishing techniques (casting, jigging, fly fishing) are still under-utilised in the region and, with the notable exception of Christmas Island, sport fishing tourism in remote or small islands is in the very early stages. If successful, this sport fishing development project in Cook Islands could become a model for other Pacific Islands to follow.

THE SPORT FISHING RESOURCE

Despite the brevity of the study, the main features of the natural resources of interest to sport fishing were identified: 1) In a small lagoon on the southeastern side of Rarotonga (Muri Lagoon) were a good number of small-to-medium size fish that could either be spotted or caught using ultra-light casting gear and tackle (island, brassy and blue-fish trevallies, goatfish); 2) A barrier reef with several narrow passages and "points" that, according to MMR staff and local



Satellite view of Rarotonga (Image: SOPAC).

fishers, can be very good fishing areas; and 3) An ongoing FAD programme with five FADs deployed and sporadically very productive (yellowfin tuna and wahoo).

Aitutaki on the other hand offers: 1) a large lagoon with several ecosystems (mangrove, sandy areas, coral heads, "motus", "flats") and numerous fish; good catches of small-to-medium size cods, brassy and bluefin trevallies and snappers were caught using ultra-light and light casting gear and tackle; 2) a long barrier reef with several narrow passages and three main "corners" where good fishing occurred using medium and heavy casting tackle (bluefin and giant trevally, emperor) and jigging gear (dogtooth tuna, including several strikes of "monster" ones but none were landed); 3) an ongoing FAD programme with five FADs deployed and sporadically very productive (yellowfin tuna and wahoo).

At the time of the study, bonefish fishing was the main topic of discussion on Aitutaki, with

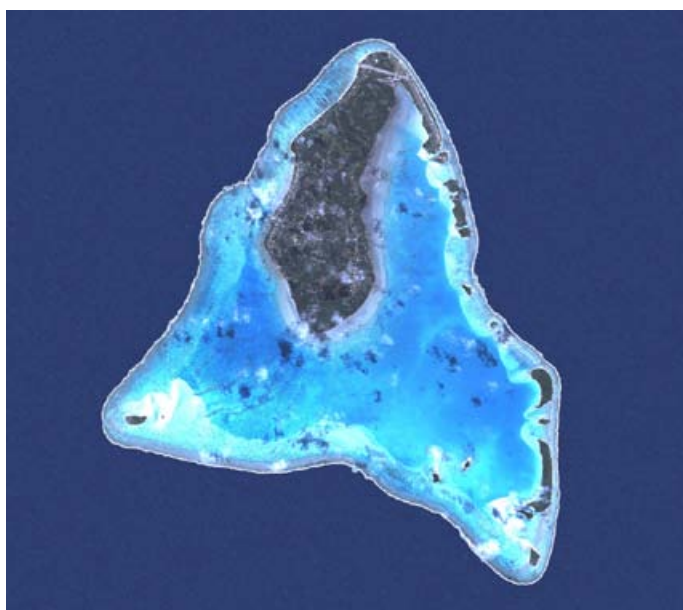
a strong will to develop a tourism-oriented fly-fishing industry. Most of the people we met were critical of net-fishing for bonefish when this does not follow local bylaws limiting net length and mesh sizes and when it targets spawning aggregations (reports were made of "thousands" of bonefish caught in one trip and ending up as pig feed). There were two schools of thought among local decision-makers and policy-makers: one is in favour of a ban on net fishing and net imports on the island, the other prefers to raise awareness among net fishermen and if possible make them change occupations to become fly-fishing guides. Two exploratory trips were made on the flats and several bonefish could be spotted. Pictures of fly-fishermen with large specimens (5 kg +) were seen in one local restaurant. The largest bonefish aggregations are reported to occur between August and December.

SOCIOECONOMIC AND ENVIRONMENTAL CONTEXT

The socioeconomic context seems conducive for sport fish-

ing development in both Rarotonga and Aitutaki due to the following.

- A well-developed tourism sector with an overarching body (Cook Island Tourism Corporation) willing to diversify the range of activities available to visitors.
- Easy access to both Rarotonga and Aitutaki (direct flights from Auckland, New Zealand and Los Angeles, USA (and soon Hawaii), four daily flights between the two islands).
- A wide range of options for quality accommodation from five star hotels to motels, guest houses and backpackers quarters.
- The "exoticism" of Cook Islands and the tradition of kindness and hospitality of its population.
- A "nucleus" of sport fishing operators that are well-established (Rarotonga) or new (Aitutaki).
- Some charters boats suitable for offshore big game fishing, mainly around FADs.
- A unanimous will among all fisheries and tourism stakeholders to develop tourism-oriented sport fishing (i.e. MMR, local politicians, fishing industry, charter operators, small-scale fishers, hotel managers).
- One only minister for both the tourism and fishing sectors.
- The involvement and efficiency of MMR and its excellent working relationship with fishers in Rarotonga and Aitutaki.
- A nascent Rarotonga Fishing Club whose President is an ex-staff member of MMR and himself a big game fishing operator.
- A fishery resource that appear limited, especially in Rarotonga, but sufficient for introducing modern sport fishing methods.
- An "icon" fish (bonefish) in Aitutaki, which could gener-



Satellite view of Aitutaki (Image: SOPAC).

ate dedicated, international, sport fishing tourism similar to that of Christmas Island.

- The presence of ciguatera in both Rarotonga and Aitutaki, which limits subsistence and commercial fishing of reef fish species and thus benefits this resource.

However, some potential constraints to developing sport fishing operations are the following.

- Specialised sport fishing gear and tackle does not exist in the Cooks and would have to be imported.
- The majority of existing charter boats seem unsuitable for “casting” and “jigging” methods; the safest and most comfortable boats for these fishing methods are open-decked boats with a central console.
- Suitable fishing areas are limited in size in Rarotonga, which will mean a limit on the number of charter operators specialising in casting and jigging methods, and the strict applica-

tion of the “catch-and-release” principle.

- Some potential conflicts between the different users of the bonefish resource in Aitutaki: net fishermen, fly-fishing guides, operators of lagoon-based activities (glass-bottom boat, snorkelling, etc.).

Based on the above context and discussions with stakeholders, the following options for sport fishing development have been put forward.

In Rarotonga, where the big game fishing sector appears sustainable and sufficiently developed, and where fishing zones are limited, it seems possible to diversify sport fishing by introducing casting and jigging techniques. Small charter operators could take tourists casting and jigging on the barrier reef when FAD fishing is quiet. In addition, Muri Lagoon could easily support some ultra-light casting activity provided the number of operations is limited, captured fish are released, and some arrangements are made to allow

sport fishing by tourists in the “raui” (a traditional closure on a resource). Fishing from the beach or using kayaks is possible in Muri Lagoon.

In Aitutaki, a real sport fishing development could occur based on more abundant and varied resources than in Rarotonga. Several “products” have been identified with two potential iconic fish species: the bonefish and the dogtooth tuna. Both fish, especially the former, may possibly attract fishing enthusiasts from the Pacific Rim and possibly Europe, and doing so would generate substantial benefits for the local community. However, prior to marketing Aitutaki as a fly-fishing destination, a thorough evaluation of the bonefish resource and a participatory management plan for the fishery need to be carried out.

Action plans for developing both casting and jigging operations and for bonefish fly-fishing products were subsequently proposed to MMR.



Consultant Etienne Picquel with a good size dogtooth tuna caught on a jig in Aitutaki.



Pepe Pepe (mayor of Hollywood, Aitutaki) and Etienne with a bluefin trevally caught jigging.

Richard Story (MMR) and Etienne with a nice giant trevally caught jigging and ready to be released.



ACTION PLAN FOR BONEFISH FLY-FISHING IN AITUTAKI

1. Resource assessment and bonefish management plan

This would be conducted jointly by MMR and SPC, with inputs from local fishers and one bonefish fly-fishing expert or tour operator. The study will identify the best fishing areas and seasons and the number of potential guides needed. The management plan will, among other things, revise existing bylaws in relation to bonefish fishing and clarify the role of other users of the lagoon (tourism service providers).

2. Training local fly-fishing guides

This would be undertaken as part of 1 above. A limited number of potential guides (three to four) will need to be identified beforehand by the local government, preferably among the group of net fishermen.

3. Coordination and monitoring bonefish fishing

If the activity develops, an association of bonefish fly-fishing guides could be established, with an Executive Officer position. The Executive Officer would be tasked with coordinating bookings and liaising between clients or tour operators and local service providers (hotels, guides). It is also advised that one person be identified, preferably amongst the local government, to monitor the fishing activity and ensure the rules of the management plan are adhered to.

4. Marketing Aitutaki as a bonefish destination

International tour operators specialising in bonefish fly-fishing will be invited to Aitutaki to "test" the resource, the quality and range of hotels, and the skills of the local guides. The Cook Islands Tourism Corpo-

ration might be in a position to facilitate such visits. The fly-fishing guides association will also need to be equipped with a website so as to market the Aitutaki bonefish directly.

ACTION PLAN FOR CASTING AND JIGGING IN RAROTONGA AND AITUTAKI

1. Multidisciplinary training for casting and jigging charter operators

This training aims at preparing prospective guides for commercial sport fishing activity in the tourism sector. One component or module would include training in first aid, hospitality and tourism, small business management, and sea safety. MMR would have to coordinate the development of this module with relevant training institutions in Rarotonga. In addition to this generic training, a second module would cover the specific technical skills involved in casting and jigging fishing methods. The training, delivered by a professional fishing guide, would include fishing gear, tackle and maintenance, preparing for a fishing trip with customers, as well as several fishing trips using those methods and catch-and-release principles. Trainees will be selected by MMR based on their professional experience, motivation and skills. While this fishing module could be delivered in both Rarotonga and Aitutaki, it seems preferable and cheaper to initially run the training at one location, with participants from both islands. It is also suggested to limit the number of participants to six (three from each island).

2. Demonstration casting and jigging gear and tackle

Given the total absence (and high cost) of casting and jigging gear and tackle in Rarotonga, it is suggested that MMR acquire a few sets of rods, reels and lures that will be rented on a daily

basis to those local guides who received training (as described above). Once familiar with the fishing gear and associated fishing methods, local guides will be in better position to purchase their own fishing equipment. Casting and jigging gear and tackle comes in a wide range of brands, qualities and costs. For demonstration purposes however, it is suggested that medium to high quality, durable rods and reels be acquired. Some examples of gear sets and accessories with model names and prices were provided to MMR.

3. Upgrading of charter fishing boats

While the largest big game charter boats appeared adequately equipped with electronic and safety equipment, some of the smallest charter vessels (of the "potimara" type) would need to acquire additional safety equipment. In addition, jigging is greatly facilitated by using an echo sounder, which not all operators have onboard their vessels. The purchase of fighting belts, gloves and rod-holders is necessary for the smallest charter vessels. This cost of upgrading vessels will differ for each charter operator.

4. Communication network and monitoring of casting and jigging activity

It is proposed to establish a communication network among the various groups concerned by sport fishing development (hotels, Cook Islands Tourism Corporation, Rarotonga Fishing Club, fishing guides and MMR). This communication network may take the form of an Internet-based sport fishing discussion group, through which news and information of interest could be dispatched.

At Aitutaki, if casting and jigging methods take off, MMR via the Aitutaki Marine Research Centre, could advise lo-

cal guides and monitor their activity as it already does with commercial tuna fishers. To that effect, it is proposed to attach for a short period one MMR staff to a commercial sport fishing venture in the region.

5. Promotion and marketing of casting and jigging sport fishing

Unlike bonefish fly-fishing, which may attract visitors as far away as Europe, casting and jigging will likely be of interest to sport fishers from countries with existing tourism links with the Cook Islands (e.g. Zealand, Australia and, to a lesser extent, the US west coast). Once local guides have been trained and equipped, promotion of the Cook Islands as a fishing destination will be done in the same manner as for bonefish fly-fishing, by inviting sport fishing tour operators. Promotion and bookings will also be possible using Internet and websites of interested hotels and of (some) charter operators. The contrast-

ed destinations and fishing in Aitutaki and Rarotonga would make it possible to market "fishing packages" that could include trolling around FADs, ultralight tackle casting at Muri Lagoon, jigging for black trevalies in Rarotonga, lagoon light casting, outer reef casting and heavy tackle jigging for "giant" dogtooth in Aitutaki.

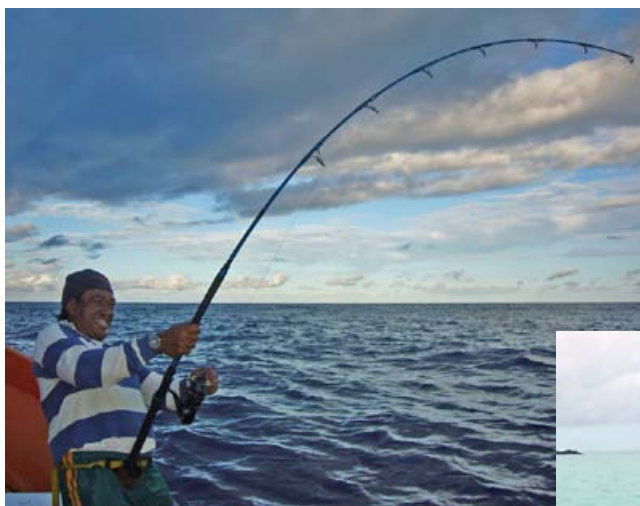
CONCLUSION

The desire to develop Cook Islands as a sport fishing destination is shared by most people in Rarotonga and Aitutaki. The socioeconomic context appears conducive and fishing trials suggest that the resource is sufficient enough to diversify (in Rarotonga) or develop (in Aitutaki) sport fishing for specialist anglers and the average tourist.

The limited fishing areas in Rarotonga imply a precautionary and gradual approach with a controlled fishing effort, a small number of guides, and the application of catch-and-release

principles. The potential for development appears higher in Aitutaki due to a smaller population and a larger lagoon. The dogtooth tuna and the bonefish are the possible iconic fish for this destination. The willingness to develop a bonefish fly-fishing industry is high on the island but preliminary actions are required, including a detailed resource survey, a participatory management plan, and some training for prospective local guides.

To achieve this ambitious development plan, MMR will need to secure financial resources and it will need to work closely with the tourism sector and the local fishing community. SPC's Coastal Fisheries Programme will continue to provide technical assistance to MMR as required, in order for the Cook Islands to be a model of sport fishing development that other interested Pacific Island countries can learn from.



Etienne, ultra-light casting in Muri lagoon, Rarotonga.

Pepe Pepe in full action while casting outside the lagoon of Aitutaki.



COASTAL FISHERIES MANAGEMENT SECTION

Sub-regional workshop on the ecosystem approach to coastal fisheries management held in Guam

A sub-regional workshop on the ecosystem approach to managing coastal fisheries in Pacific Island countries was held in Guam from 30 March–3 April 2009. The workshop was conducted for Micronesian countries and the northern Pacific region, and was jointly funded and coordinated by the UN Food and Agriculture Organization, SPC and The Nature Conservancy.

Like the sub-regional workshop conducted for the South Pacific region in Nadi, Fiji in 2008, the initiative was in response to needs identified by the “Pacific Islands Regional Coastal Fisheries Management Policy” (referred to as the Apia Policy), which calls for implementing the ecosystem approach to fisheries (EAF) management in Pacific Island countries and territories (PICTs).

Workshop objectives were to:

- further elaborate on concepts and principles to implement EAF;
- further familiarise PICTs with EAF principles and practices;
- review priorities to implement EAF management practices in PICTs, with an emphasis on coastal fisheries;
- review obstacles in implementing EAF management practices in the region and find ways to overcome them; and
- draft a programme of action for improving EAF implementation in PICTs.

Eighteen participants from Guam, Federated States of Micronesia (FSM), Marshall Islands, the Northern Mariana Islands, and Palau attended the workshop. In FSM, the responsibility for managing coastal fisheries lies with each state;

therefore, six participants were representatives of the four FSM states and one was a representative of the national government.

The workshop covered a wide range of issues and processes needed for implementing EAF management in PICTs, including (among others) EAF principles and processes, risk assessment and risk analysis, existing processes within countries, developing fisheries management plans consistent with EAF, and developing an EAF management strategic plan for PICTs.

The five-day workshop concluded with comments and recommendations for implementing the EAF management in participating countries, including:

- The EAF process is good but needs to be defined and applicable to the local context;
- It may be difficult to include communities in the process. Currently, the process is applicable to the manage-

ment/industrial level but needs to be redefined to address communities given the management, resource use and ownership of resources by communities.

- The FAO tool-kit for EAF needs to be adapted to the Pacific region.
- Other tools are available within the region, and these will enable stakeholders to formulate a process that is applicable in the respective country.
- Biologists and researchers also need to be aware of and involved in the EAF process.
- A data gap assessment will identify any available and relevant scientific and cultural information relating to EAF.



Participants debating and sharing ideas at the EAFM workshop in Guam.



Participants to the Guam workshop.

Tonga's national ecosystem approach to fisheries management workshop

The community-based ecosystem approach to fisheries (EAF) management workshop for Tonga was undertaken as part of SPC's continuing role in supporting national fisheries agencies with implementing an ecosystem approach to managing coastal fisheries. This initiative was prompted as a result of a directive from Pacific Island Forum Leaders to SPC to promote EAF management as part of fisheries management in the region and, an obligation by SPC's Coastal Fisheries Management Section to support Tonga's community-based fisheries management programme (CBFMP).

The workshop's main objectives were to build the capacity of Tonga's CBFMP staff, review Tonga's CBFMP, and incorporate EAF principles to current fisheries management programmes and practices.

With a wide range of representatives from government departments, non-governmental organisations and participating communities in the CBFMP, the workshop offered a consultative framework for developing an EAF management model to be implemented in Tonga. This model takes Tonga's cultural and traditional protocols into consideration.

The five-day workshop consisted mainly of presentations and discussions. Major presentations were delivered by Dr Michael King (consultant), Ueta Faasili (SPC's Coastal Fisheries Management Adviser) Etuati Ropeti (Coastal Fisheries Management Officer) and selected speakers from Tonga's Fisheries Division and the Department of Environment.



Participants to the Tonga workshop.

Developing an ecosystem approach to coastal fisheries management for Pakin Atoll, Pohnpei

"The model used to implement the ecosystem approach for the management of coastal fisheries in Pohnpei State is ours. It was developed by state authorities, community representatives and our partners" Donald David (Administrator for the Office of Fisheries and Aquaculture)

SPC's Coastal Fisheries Programme, in response to a request from the Pohnpei State Government (through the national government of the Federated States of Micronesia), assisted with developing a management programme for Pohnpei's coastal fisheries resources. A preliminary study to assess the local situation in terms of staff, resources, existing management efforts, and how SPC could assist was conducted in 2007. This was followed by a consultative workshop and an attachment programme for two officials from Pohnpei to SPC to develop a management model for resource management. Representatives from the State Gov-

ernment (Office of Fisheries and Aquaculture, OFA) and the Conservation Society of Pohnpei (CSP), a local non-governmental organisation, undertook the attachment. The model considered existing management efforts by CSP, community organisations and state partners. With financial assistance from AusAID to Pohnpei State (Office of Fisheries and Aquaculture) and major support from other partners, a resources management programme for Pakin Atoll was implemented.

Pakin Atoll is approximately 45 km northwest of Pohnpei. The atoll consists of 17 small islands and islets with a barrier reef sur-

rounding the group. The atoll has a land area of about 0.67 km². Five of the islets are inhabited, and the island of Nikahlep is the atoll's main centre. The atoll's lagoon is estimated to be 8.8 km², with the deepest part at around 100 m. The lagoon and surrounding coastal areas provide food and livelihood for the community and is considered to be one of the richest marine ecosystems within Pohnpei State. The atoll has an estimated population of 120 residents with the main sources of income coming from fishing, copra production and small-scale agriculture.

The atoll's community is a recipient of a pearl trial project

funded and run by the College of Micronesia Cooperative Research and Extension. The project works with island communities as a component of integrated economic development. The objective is to work on pilot pearl farms that will eventually be turned over to communities as income-generating activities. The trials provide a platform for community participation and “hands on” training in farming and grow-out operations.

FISHING AND STATUS OF FISHERY

In the past, the main fishing techniques used specialised spears, hooks, and lines made from plant materials, all of which were made in accordance with tradition. Fishing gear was blessed by community chiefs, with certain gear used for particular species and for specific occasions. For example, it was forbidden to fish at night for parrotfish — which was highly prized and had cultural significance.

The use of traps built of stone walls near the shoreline was one important fishing method used in Pakin. A fish school was driven through an entrance of the wall where they were then trapped within the wider end of the trap. The fish were kept inside the trap for days and were harvested for consumption on a daily basis and when the need arose.

Traps made of hardwood were also commonly used in the lagoon area. These traps were

baited and left in the water for several days. Fishers would selectively harvest certain fish for consumption.



Detail of a wooden trap commonly used in the past.



Remains of a stone trap.



Using an icebox while speafishing.

The introduction of “ice boxes” coupled with new, highly efficient fishing gear and techniques

resulted in a change in how people fished and their attitudes towards the marine environment. Traditional fishing practices have disappeared, and the uncontrolled harvest of some marine species is becoming noticeable in lagoonal areas.

With an increasing human population and a shift from a primarily subsistence lifestyle to a cash-based economy, coastal fisheries resources and coral reef ecosystems are being subjected to enormous pressure not only from the island community but the main island of Pohnpei. A rapid ecological assessment and market surveys recently conducted by CSP and OFA have revealed that coastal fisheries resources in the area are declining. Anecdotal reports also reveal a decline in most of the important fish and shellfish species around the atoll.

A COORDINATED APPROACH

With a request for assistance from the Pakin community, OFA and CSP sourced financial resources for implementing the programme. Experiences from existing community-based resource management programmes revealed a limitation on responsible authorities to undertake management activities. This is due mainly to the fact that some undertakings fall under the jurisdiction of other authorities and, therefore, a coordinated approach needs to be taken. This has resulted in the development of the Pohnpei State Project Team. The team

comprises representatives from various authorities such as OFA, CSP, Tonga's Department of Lands and Natural Resources, the Environmental Protection Agency and the local municipality. SPC's role is to facilitate the process and offer technical advice when needed.

DEVELOPING THE PAKIN FISHERIES MANAGEMENT PLAN

Through community consultations and discussions, fisheries problems (and their causes) as

well as management undertakings were identified. The authorities responsible for performing these undertakings were identified.

A Fisheries Management Committee was established to liaise with the project team and to coordinate community actions. The committee consists mainly of representatives from various community sectors.

Pakin's Fisheries Management Plan, which is now in draft

form, highlights the need to manage fisheries resources in a sustainable manner. The undertakings highlighted in the plan require the community to take the leading role, while members of the project team address these issues within their respective department or organisation. Some of the undertakings require the combined effort of the project team and some involve decision-making at the highest level of the state government. The project team provides the technical assistance and support for community activities.



Participants to the community consultations and workshops.

In the absence of substantive information or scientific assessment, the objective of the management plan is to impose sensible and locally relevant principles of a precautionary approach to exploiting coastal fisheries resources. The management plan also highlights some alternative income-generating activities to reduce the pressure on fishery resources.

SPC's Coastal Fisheries Programme will continue to assist in developing the final copy of the Pakin Fisheries Management Plan, while also providing technical support when required.



Members of the Pakin Fisheries Management Committee with the project team.

■ AQUACULTURE SECTION

Aquaculture updates from Papua New Guinea

In March 2009, SPC's Aquaculture Adviser, Ben Ponia, visited Papua New Guinea (PNG) to assess SPC programming assistance in that country. He was assisted by counterparts from PNG's National Fisheries Authority (NFA) including NFA's Aquaculture Manager Jacob Wani. Several locations were visited to view recent developments and some observations from that visit are provided here.

DARU ISLAND, WESTERN PROVINCE

Daru Island is the capital of PNG's Western Province, and is the largest province in the country, although it is sparsely populated and is one of the least developed. The Ok Tedi gold mine is the main source of revenue. Daru Island itself is small, just 5 km long and 3 km wide. It forms part of the Torres Straits group and sits at the junction between the border of PNG, Australia and Indonesia. The official population is around 15,000 but the number swells when Fly River claimants to Ok Tedi royalties visit the island to receive their payments and trade goods. During our visit, the foreshore was covered with many dugout canoes with makeshift tents. Some people travelled for as many as four days down river. The town is a hotspot of social problems including alcoholism and high rates of HIV.

The Ok Tedi Mine is funding (10 million kina – As of June 2009, 1 USD = 2.7 PNG kina) the Western Province Sustainable Barra-

mundi Project, with Ian Middleton serving as project manager. The project aims to provide economic and social development by 1) farming barramundi in cage pontoons along the coast and inland freshwater bodies, 2) restocking barramundi in the Fly River to encourage eco-tourism fly-fishing, and (3) supporting habitat and biodiversity conservation in Morehead and Suki wetlands and the wider Trans Fly eco-region, which includes West Papua (Indonesia).

- The eight-hectare barramundi project site was half-way through construction during the time of our visit. The hatchery design has 12 indoor tanks, brood stock tanks and a large saltwater header tank that will gravity feed two earthen ponds for fingerling grow-out. The facility will have shared accommodation for four hatchery staff. A later extension phase will include housing for the hatchery manager and visiting scientists, and a jetty beyond the inter-tidal zone.
- The barramundi hatchery capacity is 500,000 fingerlings

per year, and 20 breeders are already being conditioned. The first barramundi harvest is scheduled for April 2010. Ian has recruited experienced staff who previously worked at his barramundi farm in Madang. Once construction is completed, fish breeding will begin immediately.

- We visited sites for fish grow-out. At the time, there was a fuel shortage due to shipping delays and purchases from royalty payments, so we observed first-hand the soaring fuel prices charged on the "black-market" (up to 15 kina per litre).
- We crossed the channel separating Daru Island and the PNG mainland to Pama Island, which has a village of about 800 people. The school principal, Wesly Kiwi, worked on Ian's farm in Madang and will be responsible for pontoons in the area. He intends to provide supplementary feed to the barramundi by gillnetting "trash fish", especially garfish species. Another area for grow-out will be Katatai village, located at the mouth of the Fly River (which is about 70 km wide). Pontoons will also be deployed by project staff in Daru Island channel, at an old pearl farm site.
- SPC is interested in collaborating on barramundi tag-and-release experiments in the Fly River as they could provide lessons for other Pacific Island countries interested in culture-based freshwater fisheries. SPC is also involved in an Australian Research Centre for International Research (ACIAR) mini-project



Dugout canoes, with makeshift tents, moored at Daru Island.

with Ok Tedi staff to assess Fly River herring as a possible fishmeal or supplementary feed source for the barramundi project.

Crayfish tails and barramundi are important fishery exports, and the main exporter on Daru would like to transship through Australia to the USA. However, there have been difficulties with Australian quarantine dept related to traceability issues that we hope will be addressed through a biosecurity and trade project. The management of the invasive snakehead from Indonesia is also a pressing issue as this species is becoming widespread and is now sold on the local market. Staff in Daru Island have offered to assist the ACIAR mini-project by collecting local *Penaeus monodon* shrimp for analysis at Australian Commonwealth Scientific and Industrial Research Organisation to assess the disease status of shrimp.

One of the main problems for provincial fisheries departments is the lack of resources for management and surveillance. Fisheries are becoming overfished and fishers are poaching from the Australian maritime area. Turtles and dugongs are caught and sold with few regulations. The sea cucumber fishery is one of the most important fisheries for coastal villagers but the sizes that are being harvested are becoming quite small (as little as 7.5 cm). Fisheries officials also described their concerns for the freshwater ornamental Saratoga fish stocks because villages along the Fly River have been deliberately targeting juvenile fish that are stockpiled in cages and later sold to Indonesian traders across the border.

LAKE, MOROBE PROVINCE

We were unable to travel to Lae but met with a representative from Bris Kanda, a non-governmental organisation currently

implementing a large NZAID rural enterprise development project for the Huon Gulf area. According to Lukis Romaso, project manager, the tilapia pond-farming component of the project has expanded faster than they had anticipated. They began in 2008 with 20 tilapia ponds and now have about 100 ponds that are supplied by a satellite hatchery. The fish are sold in villages at 12 kina each, but they would now like to sell them in the main market in Lae where they believe that there is a strong demand. SPC will assist in this commercialisation phase.

SPC was requested to assist with a Japan International Co-operation Agency project in Lae, which is supporting community-based aquaculture. The Aquaculture Section of SPC believes there is an opportunity for fattening mud crabs in the mangrove and may carry out some trials.

NAGO ISLAND, NEW IRELAND PROVINCE

Nago Island is a small uninhabited islet located just off the town of Kavieng. It is the site of the new NFA Nago Island Mariculture and Research Station, which is currently under construction. NFA has secured 11 hectares of land connected by a jetty. The station has a hatchery, algal laboratory and "wet" laboratory and indoor and outdoor larval tanks and raceways, with replicates and free spacing set aside for experiments. There is a separate area for quarantine. There are also offices and two resident houses onsite for staff. Because the island is uninhabited, the facility will be fully self-sufficient in providing its energy and water needs.

Nago Island also has tourism potential and NFA intends to sub-lease part of its land to Nusa Resort to build some

tourist accommodation. It is intended that the resort and station will share power and water utilities, an interesting example of public and private sector partnership. Nusa Resort already runs a successful eco-tourism/surfing bungalows operation on the neighbouring island.

Hugh Walton (Principal for the National Fisheries College) is project coordinator and Peter Minimulu from NFA is hatchery manager. We discussed projects that might help commission the facility once it is completed. Project ideas included, trochus community restocking trials, cage farming rabbitfish, introducing *Kappaphycus* seaweed, mariculture marine ornamentals and mabe pearl culture trials.

A quick visit to the National Fisheries College was made to see a small tilapia hatchery and ponds that Peter has established as a part of the college's (introductory and advanced) course.

Postscript: after our visit, John Morrison from James Cook University was engaged by NFA to review the hatchery designs and specifications and he provided very useful suggestions.

RABAUL

Peter Cooper is the General Manager of the Carpenters Company in Rabaul, which is farming black tiger shrimp (*Penaeus monodon*). Carpenters is a large trading firm and exporter of tea, cocoa and copra. The first crop of shrimp (12 t) was harvested in 2008. It is a fairly large operation with about 10 x 0.5 hectare earthen ponds with a capacity to produce 80 t of shrimp per year. At the time of our visit, the farm was preparing for a harvest the following week. This harvest was forecasted to be around 24 t, of which 4 t would be sent to Fiji.

The farm has a new purpose-built processing facility. Sorting, grading, freezing (-35°C) and packaging the harvested shrimp is all done onsite. The facility has a capacity for about 1 t per day and during peak processing periods an additional 20 workers are hired (mostly female). The facility has passed NFA's audit section's food safety standards.

The hatchery is located close to the staff com-



Farmed black tiger prawn from Rabaul.

pound and is run by a hatchery manager recruited from Indonesia. One ongoing problem is the lack of brood-stock around Rabaul, so live breeders have been sourced from trawlers operating in the Gulf of Carpentaria. The hatchery has a high use of probiotics (bacteria) to feed its larvae.

The Rabaul "Tovarur" shrimps retail at 47 kina per kg, and the taste is delicious!

Meeting announcement: Tilapia Summit meeting

SPC's Aquaculture Section will hold a tilapia summit meeting in December 2009.

This will be a Pacific regional meeting to address strategic issues in tilapia fish aquaculture for Pacific Island countries and territories.

Inland aquaculture of freshwater fish in small ponds has been identified by regional policy-makers as one of three main "Fish for Food Security" strategies, to meet the needs of increasing populations and as a vehicle for adaptation to climate change.

In all other tropical regions of the world, tilapia aquaculture has been developed to the point where it is now regarded as "the aquatic chicken". Tilapia has been present in most parts of the Pacific Islands region since the early 1960s but, with a few exceptions, tilapia aquaculture has not yet been developed to any great extent. There is huge potential still waiting to be achieved,

although some constraints still to be addressed.

The purpose of the Tilapia Summit will be to:

- share experiences from within the region, and from outside (Asia, Africa, South America), to identify constraints;

- identify the most appropriate project models and development pathways for tilapia aquaculture under Pacific Island environmental and social conditions; and
- establish a regional "road-map" for the sustainable development of tilapia aquaculture in the Pacific.



A mouth-brooding tilapia female inspected by Solomon Islands fisheries aquaculture staff.

The Tilapia Summit will be of interest to all of those engaged in the fields of Pacific aquaculture development, food security or climate change adaptation. Participation is open to SPC member country government and territory administrations, as well as representatives from private-sector aquaculture, academic institutions, NGOs and civil-societies active in these fields. Some funding is available for government representatives from selected SPC countries and territories.

For more information, contact SPC's Aquaculture Officer Tim Pickering at: timp@spc.int

Teaming up for sustainable ornamental aquaculture in Tonga

In April 2009, SPC, Walt Smith International (WSI) and Tonga's Fisheries Division combined efforts and resources to develop a coral and live rock farm aimed at supplying the international aquarium market. This project, mostly funded by the Australian Centre for International Agricultural Research (ACIAR), also has significant in-kind contribution by all three stakeholders.

BACKGROUND

Tonga's marine aquarium fishery has been developing over the past 20 years. It supports jobs in rural, low-income coastal areas, and has operated on mutual management and compliance effort since its inception and is now establishing a fisheries management plan. As a result, a specific aquarium fishery management plan has been drafted in consultation and cooperation with other stakeholders, including government departments, tour operators, aquarium industry personnel and fishing communities.

However, the Tongan government, under pressure from some environmental groups has decided (as a precautionary approach) to put a ban on live rock harvesting (previously 50 tonnes a year) in August 2008, and to bring coral quotas down from 300 pieces to 150 pieces per exporter per week. This has led to the closure of two private companies (out of five) and the dismissal of many employees of other companies. The closure has also induced the live rock trade to switch locations (e.g. to Vanuatu and Indonesia).

INITIAL TRIALS

During the SPC marine aquarium trade conference in December 2008 (see previous issue of this newsletter), Tonga's Fisheries Division approached SPC to develop a project proposal that could assist motivated Tongan companies to venture into the aquaculture of corals and rocks. As part of the ACIAR-funded aquaculture mini-project scheme, SPC agreed and ap-

proached WSI to be the project partner, given their extensive experience in farming both of these commodities in Fiji.

The first step of this project was to make the best use of the existing flow-through aquaculture facilities at the Sopa Mariculture Centre. During the initial visit to Tonga, Walt Smith lent his entire crew to help the staff of the Fisheries Division and SPC to rehabilitate the facility and make it ready for the new coral farm. Once the tanks were ready, appropriate brood stock was collected under the supervision of Chris Turnier, WSI biologist and coral expert. He rightly pointed out that only what the aquarium industry wants should be collected and grown, otherwise it will be a wasted effort. The newly acquired corals were carefully placed in several hold-

ing tanks at the Fisheries Division, awaiting the fragmentation process where one piece of coral is turned into 50 or more cuttings. Both WSI and Fisheries Division staff were trained in fragmenting and planting coral colonies. Once cuttings are made from a mother colony it takes only about four to six months to grow them to the ideal market size ready for export.

At the end of this initial trip to Tonga, the team (staff from WSI, SPC and the Ministry of Fisheries, accompanied by Scott MacTier, an aquaculture volunteer from AusAID) was able to plant over 3,000 new coral fragments and over two tonnes of man-made live rock. The team intends to return to Tonga soon for the second installment of this project, which will include planting coral on racks placed in the ocean in preparation for community-based projects. The goal is to have over 40,000 pieces of coral planted and 25,000 tonnes of live rock in the water during the first few months of the project.



Acropora clathrata broodstock.

Artificial rocks, made of concrete, in a raceway at the Sopa Mariculture Centre.



WHAT IS THE FUTURE FOR THIS ACTIVITY IN TONGA?

Tonga's Fisheries Division has been very supportive of this project because it has the potential to bridge the gap between the marine ornamental industry in Tonga and the national government, with a better understanding of just how renewable the resource is. . Currently, the industry is under a lot of pressure from groups that do not think that coral and rock harvest can actually be sustainable. Culturing corals and rocks is one way to engage communities and government to create awareness regarding coral reef issues and the use of a renewable and sustainable resource. In Tonga, there are very few natural resources that can be export-

ed and if the resource is proven sustainable it will make a valuable contribution to the Tongan economy.

The Fisheries Division thinks that this project will benefit the environment and help to negate suspected excessive depletion of the resource by the aquarium trade. It is an exciting time and the marine ornamental industry should embrace this chance to be involved. Unfortunately, until the ban is lifted, the industry is suffering from a lack of export dollars to invest in such a project. The industry hopes that the knowledge gained from this exercise will enable the Ministry to re-establish the original quota in order for the trade to survive long enough to put this technology to use for the benefit of the

communities, the Tongan economy as well as our industry.

For more information on this project, contact:

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The first fragment mounts made in Tonga.



Cutting fragments of *Acropora millepora*.



Kautai, from Walt Smith International, sticking a fragment of *Acropora millepora* in a cement mount.

NEW CALEDONIAN FISHERIES OFFICERS RETURN WITH LOBSTER FARMING TECHNIQUES

In recent decades, New Caledonia's aquaculture sector has mostly focused on shrimp farming, although there is now an interest in diversifying to other marine products. New Caledonia is encouraging industries that can utilise the country's diverse and abundant natural resources to build up a small- to medium-scale aquaculture sector.

One area for expansion is the capture and culture of lobster pueruli through affordable techniques that, if deployed on an artisanal scale, could benefit households while also creating sustainable incomes. In Vietnam, lobster culture — based on wild-caught pueruli — has boomed in recent years. There, small-scale fisherfolk capture pueruli using special collection devices (Fig. 1) and sell the pueruli to middlemen, who bulk sell them to lobster farmers. All farming activities take place at sea, and are mostly concentrated in the central areas of Vietnam, around Nah Trang (Fig. 2). The main species of lobster raised is *Panulirus ornatus* (Fig. 3), which can reach 1 kg in less than 18 months.

The Fisheries Development Agency (DDR) of New Caledonia's Southern Province requested SPC's Aquaculture Section to help with organising a study visit to Vietnam's lobster farming areas. With further assistance from Dr Clive Jones from the Northern Fisheries Centre in Cairns, Australia, three fisheries officers from New Caledonia's DDR (Bernard Fao, Thomas Réquillart and Emmanuel Coutures) were attached to the University of Nah Trang (Pr Anh Tuan) for two weeks, where they visited the Nah

Trang lobster farming area for hands-on work experience. This allowed the New Caledonian fisheries officers to understand the basics of lobster farming as well as the possible impediments of applying techniques in New Caledonia.

New Caledonia's fisheries officers were able to observe and conduct activities as varied as setting up and harvesting pueruli collectors, cage grow-out techniques,

lobster feeding and husbandry, transporting pueruli, and disease management. Later on, the officers attended an ACIAR-funded international lobster symposium. During this event, they were able to meet lobster specialists from Australia, Southeast Asia and the Caribbean.

It has been observed that at times, some areas of New Caledonia have very good (although unpredictable) lobster settlement. DDR officers wish to trial the pueruli collection techniques that they observed in Vietnam and assess whether such an activity will be technically viable in New Caledonia. Once (and if) this is proven, the economics of lobster farming in New Caledonia will be worked out in order to supply a year-round commodity that will command (locally) premium prices of over USD 30/kg.

DDR has asked SPC's Aquaculture Section to assist in carrying out the initial trials of pueruli collection. Two different types of collectors (mesh nets and drilled wood) will be trialed on longline systems in New Caledonian waters from June to September 2009. Collectors will be monitored two to three times a week to assess the potential for pueruli collection in areas that are renowned for their substantial lobster settlement during winter months.

For further information, contact Antoine Teitelbaum, SPC's Aquaculture Officer (antoinet@spc.int) or Thomas Requillart, New Caledonia's DDR Aquaculture Programme Manager (thomas.requillart@province-sud.nc).



Figure 1. A net and a piece of wood with holes in it for collecting lobster pueruli.

Figure 2. Net cages used to grow-out lobsters in the Nha Trang area of Vietnam.

Figure 3: Juvenile *Panulirus ornatus* prior to their transfer to grow-out cages.

DATABASE DESIGN BY EXAMPLE: AN AQUARIUM EXPORTS DATABASE

INTRODUCTION

This article examines how to derive a conceptual or logical model from a sample export form, and how to normalise the model to reduce the risk of inconsistencies and anomalies. This methodology, described in depth in Oppel (2004) and Powell (2005), can be applied for any similar example to model a relational database.

As an example, let's say that several companies in your country are exporting marine products, in particular live reef fish for the aquarium trade. You, as a fisheries manager, decide to monitor that fishery through de-

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tailed export permits delivered by fisheries department to the exporting companies for each shipment. You want to produce various statistics by commodity, period, country of export, and local company and decide to create a database to store and query the data.

This typical scenario follows the steps explained in the FAO book "Guidelines for routine collection of capture fishery data"

(Anon 1999). The scenario begins with a policy decision (e.g. managing the aquarium fishery) that requires indicators. A data collection strategy is then defined and is followed by designing a data management plan and database. The final stages are planning and implementing the data collection scheme.

DISSECTING A SAMPLE EXPORT PERMIT

To design a database, it is often useful to obtain not only an empty form but to also gather some typical examples of special cases. For the latter, a decision will have to be made: either increase the complexity of the model to cope with these special cases, or transform them so that they fit the standard model, possibly losing information in the process. For this exercise we will assume that the sample form presented in Figure 1 is sufficient to characterise an export permit.

Certificate of Export of Marine Products

I, Harry Cover, hereby permit

AquaExportDemo,
10th Main Street
Capital city
Tumtata

To export the following products:

Commodity	Quantity	Unit	Value	Currency
Damselfish	250	Pieces	1000	USD
Butterfly fish	20	Pieces	150	USD
Clownfish	20	Pieces	300	USD
Coral (dead)	1	Kg	60	XPF

To: HK Importer & Co
5th North Road
PO BOX 41414
Hong Kong
China

By: flight HK7878, on 10th October 2001

Labels and arrows pointing to the form:

- Authorizing officer: points to "I, Harry Cover, hereby permit"
- Exporting company: points to "AquaExportDemo, 10th Main Street, Capital city, Tumtata"
- Exported commodities by quantity and value: points to the table header
- Commodity: points to "Damselfish" in the table
- Country: points to "Hong Kong" in the "To:" section
- Transport details: points to "By: flight HK7878, on 10th October 2001"
- Currency: points to "USD" in the table
- Importing company: points to "HK Importer & Co" in the "To:" section

Figure 1. Sample export permit.

The form can be divided into coherent blocks of data: name of the exporting company, name of the importing company (or consignee), general information about the export permit (authorising officer, shipping method, etc.), and finally, details about the commodities being exported.

Additionally, we can identify information that is likely to be common to different export permits, such as the authorising officer, the commodity type and the currency. These pieces of information can also be linked to other data, such as scientific names for the commodities, currency exchange rates, or authentication for authorising officers.

Once this analysis has been conducted we can start the logical design of the database.

DATABASE DESIGN

On an Excel spreadsheet, data are presented as a single flat table (Table 1) and part of the information is duplicated across rows. This redundancy of data makes the data prone to inconsistencies because any update or creation of a new attribute must be applied to all copies. A flat structure is, therefore, not recommended for data storage.

In a relational database however, data are spread into several tables and the normalisation process ensures that data are not redundant (first normal form¹) and that attributes of each table depend on the primary key and not on other attributes (second and third normal form).

From the sample form, we can derive tables for export permits, export details and companies. Reference tables are also created for countries, commodities, processing levels, currencies and fisheries officers, allowing additional attributes (country code, comments, etc.) to be attached to each reference type (Fig. 2).

Because a company can have both importing and exporting activities, a single table is sufficient and is linked twice to the export permits table: once for the exporting company and once for the importing country. Boolean attributes `COM_Company_Exporting` and `COM_Company_Importing` are used to indicate the activities the company is involved in.

In the `FIS_Export_Details` table, the quantity from the sample form has been split into two attributes depending on the volume or unit (pieces or kg), thus reducing the risk of mixing the two in subsequent queries.

In Figure 2, the symbols (key and infinity sign) at the ends of the table links indicate a “one to many” relationship: an export detail row corresponds to one and only one commodity but the same commodity can be referred to by many export detail rows.

The coherence of the normalised database is maintained through not null, primary key and referential constraints.

A “not null” constraint on an attribute makes it mandatory. In Figure 3, the date of export can't be null, therefore it is mandatory, whereas the airway bill is optional.

A primary key must be not null and unique. No two export permits will share the same identifier (`FIS_Export_Permit_ID`). The primary key is indicated in SQL Server Management Studio by a gold key icon on the left of the column name. The constraint “PK” is shown in parenthesis.

Finally, referential constraints enforce coherence between tables and ensure, for example, that it is not possible to delete a commodity referenced by `COM_Export_Details` and that when a permit is deleted, all corresponding export details are

deleted also (cascade deletion). In Figure 3, exporting company ID, consignee company ID and user ID are all references to other tables' primary key and are, therefore, called foreign keys (FK). They are materialised by a silver key icon.

CONCLUSION

The normalisation process (coupled with integrity constraints) considerably reduces the risk of redundancies and inconsistencies in the database, whether the user interacts directly with the database or through data entry forms. The conceptual design is independent of the choice of the database management system such as MS Access, SQL Server or MySQL and they all provide a way of implementing integrity constraints.

This export database is currently implemented by SPC as part of a larger coastal fisheries database that will be made available to fisheries officers in the region.

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- Powell G. 2005. Beginning database design. Wrox. 496 p.



¹ A full chapter is devoted to normalisation and formal definitions of normal forms in “Databases demystified” (Oppel 2004).

Table 1. Tabular data.

Permit N°	Officer	Export company	Commodity	Qty	Unit	Value	Currency	Consignee	Flight
2001/25	Harry Cover	AquaExp	Damselfish	250	Pcs	1000	USD	HK Import	HK7878
2001/25	Harry Cover	AquaExp	Clownfish	20	Pcs	300	USD	HK Import	HK7878
2001/25	Harry Cover	AquaExp	Coral(dead)	1	Kg	6000	XPF	HK Import	HK7878
2001/26	Harry Cover	AquaExp	Damselfish	200	Pcs	800	USD	The Big Import	TW1124
2001/27	Paul Smith	FreshExp	Coral	4	Kg	200	EUR	Europa Import	GR4451

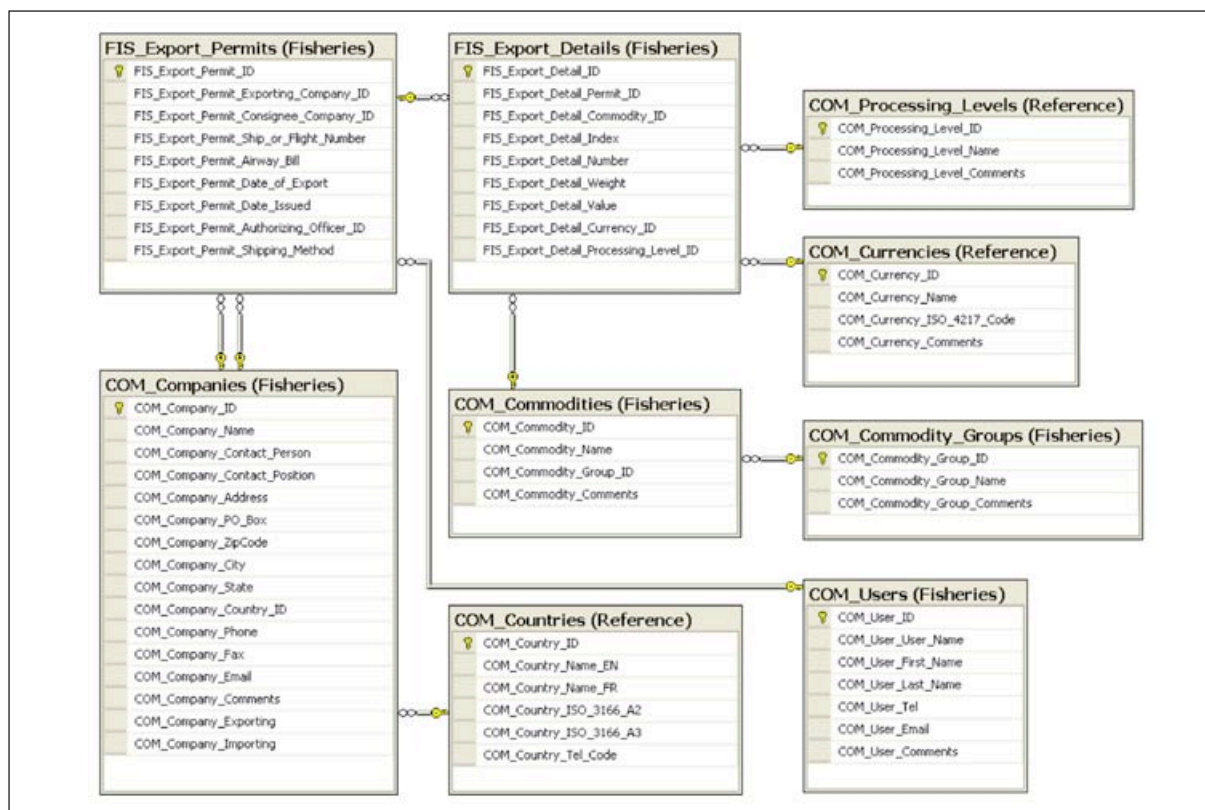


Figure 2. Database schematic.

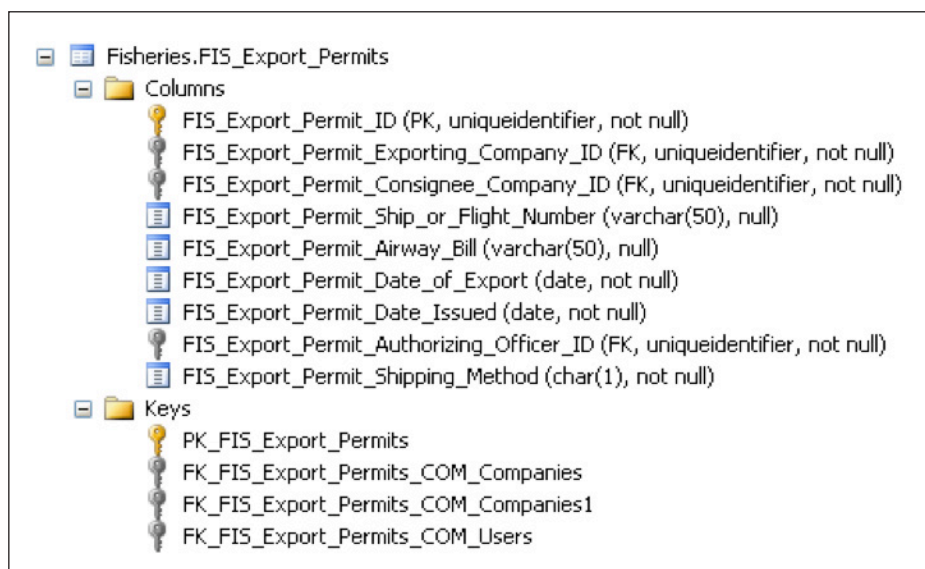


Figure 3. Columns and keys of FIS_Export_Permits table.

CORAL REEF INITIATIVE FOR THE SOUTH PACIFIC (CRISP)

The Coral Reef Initiative for the South Pacific (CRISP) comprises some 50 projects in 17 Pacific Island countries. CRISP is complex, engaging in a variety of activities with innovative implementation mechanisms that are producing a wide range of results and field data. This article explains how this multilateral programme came into being and briefly describes the different areas in which CRISP can make a major contribution to the Pacific.

PROJECT INCEPTION AND SCOPE

The initiative for the conservation and sustainable management of coral reefs in the Pacific resulted from France's political commitment to developing the region's island nations through regional integration, including greater involvement of the French overseas territories in their environment, and cooperation with Australia, New Zealand, Japan and the United States. The initiative was set up by the Agence Française de Développement (French Development Agency, or AFD) in close cooperation with the French Permanent Secretariat for the Pacific as part of an inter-ministerial approach that began in 2002. It was launched under the acronym 'CRISP' by the Minister of Ecology and Sustainable Development, Serge Lepeltier, in September 2004 during the annual SPREP (Pacific Regional Environment Programme) meeting in Papeete.

CRISP's aims are to i) develop a vision for the future of the region's unique coral ecosystems and the communities that

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depend on them, and ii) introduce strategies and projects to conserve their biodiversity, while developing the economic and environmental services they provide, both locally and globally. To this end, CRISP's main objectives are to:

- improve knowledge about the biodiversity, status and function of coral ecosystems;
- protect and manage coral ecosystems on a significant scale;
- develop the economic potential represented by the use values and biodiversity of coral ecosystems;
- disseminate information and knowledge; and
- build the capacity of and develop a leadership role within local, national and international networks.

CRISP funding was initially limited to Pacific small island states (SIS) (i.e. those states eligible for funding from the AFD or the French Global Environment Facility, FFEM), but was subsequently extended to the French overseas territories in the Pacific through supplemental funding from development partners such as Conservation International (CI), World Wildlife Fund (WWF) and the United Nations Foundation (UNF). Funding identified before the programme began is termed "joint funding", and is distinguished from "matching funding", which was generated after the programme began. A mid-term review of the programme took place in the first half of 2008, and concluded that, in total, CRISP has a funding base of some 14.5 million euros (Fig. 1).

In January 2005, a technical workshop (financed by the French Pacific Fund) was held at the Secretariat of the Pacific Community (SPC) in Noumea, New Caledonia to launch CRISP and formulate an action plan. CRISP had an initial term of three years, but in 2007 it was decided to extend the programme until late 2010. This was made

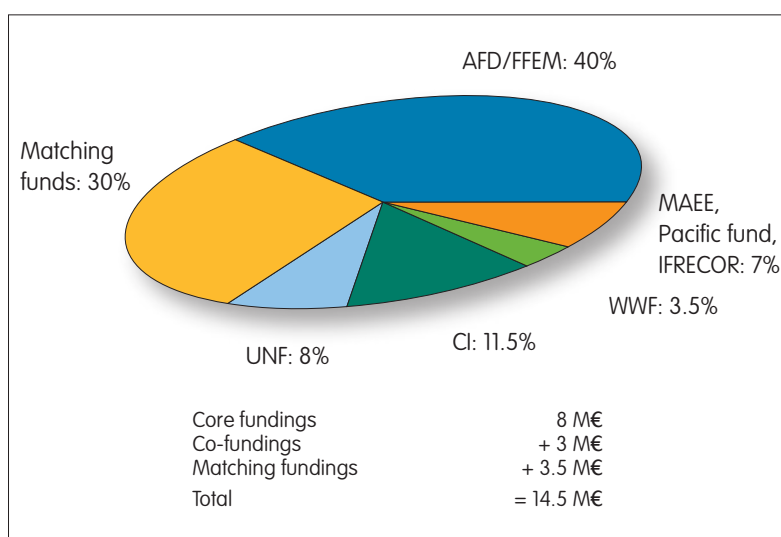


Figure 1. CRISP funding.

Table 1. CRISP work areas

Component	Topics	Contracting agency	Implementing agencies
1A	AMP support, and marine biodiversity conservation strategy	CI	WWF, CI, ASMPA, IRD140, Proscience, IFRECOR PF, IFRECOR W&F, PTPU
2A	Knowledge, monitoring, management of coral reefs, and related economical development	CNRS	EPHE-CNRS5244, USP, IRD128, Te Mana O Te Moana, Ecocean, Ibulu consultant
2B	Reef restoration	CNRS	Ginger Pacifique, FSPI, Job Consultant
2C	Bio-prospection (Active marine substances)	IRD	IRD 152, USP, University of Nantes (France)
2D	Knowledge synthesis and dissemination – ReefBase Pacific portal	WorldFish Center	WFC, CRIOBE, USP, SPREP
3A	Institutional support, governance, socio-economy and dissemination of CRISP outputs	SPREP	SPREP, Govan Consulting, etc.
3B	Monitoring and evaluation, coordination, institutional partnerships, specific researches	SPC	CRISP coordination Unit, Lasne consultant, AJH Consulting, private sector, ReefCheck, Griffith University, ICRAN, IUCN, GCRMN, etc.

ASMPA: Aleipata and Safata MPA
 CI: Conservation International
 CNRS: Centre National de la Recherche Scientifique
 Coremo: Coral Reef Monitoring
 CRIOBE: Centre de Recherches Insulaire et Observatoire de l'Environnement
 EPHE: École Pratique des Hautes Études
 FSPI: Foundation of the Peoples of the South Pacific International
 GCRMN: Global Coral Reef Monitoring Network
 ICRAN: International Coral Reef Action Network
 IFRECOR PF: Initiative française pour les récifs coralliens Polynésie française

IFRECOR W&F: Initiative française pour les récifs coralliens Wallis et Futuna
 IRD: Institut de Recherche pour le Développement
 PTPU: Pae Tai - Pae Uta
 SPREP: Secretariat of the Pacific Regional Environment Programme
 USP: University of the South Pacific
 UR 128 CoreUs: Unité de recherche 128, Approche écosystémique des Communautés Récifales et de leurs Usages dans le Pacifique insulaire
 WFC: World Fish Center
 WWF: World Wildlife Fund

possible by additional funding from the AFD and FFEM, and allowed promising activities to be strengthened, and enabled CRISP to address new issues that had arisen since the programme's formulation in 2004. CRISP is managed by a coordination unit, which has been based at SPC in New Caledonia since 2005. This unit became an integral part of SPC in April 2008, when the AFD provided additional funding designed to integrate CRISP activities into those of SPC, with a view to ensuring the sustainability of CRISP's impacts.

CRISP's work programme is divided into seven major components, as described in Table 1.

CRISP WORK AREAS

Table 1 shows the programme from a technical point of view. The programmes' results (both those achieved to date and projected results to the end of 2010) can be best understood when presented as part of the eight different topic areas that the components and projects contribute to. The eight topics are described below.

Applied ecosystem management

This is a major topic for the programme that covers all the activities that prioritise conservation. There are four objectives under CRISP:

- Improving our understanding of marine biodiversity and the threats it faces. This objective will be achieved by conducting three eco-regional analyses (ERAs). Two sub-regional analyses are being carried out by WWF in the New Caledonian and Polynesian (French Polynesia and Cook Islands) eco-regions. Another analysis is being conducted at the Pacific regional level by CI.
- Providing a major contribution towards setting up and strengthening marine protected areas (MPAs) as a coral ecosystem conservation and sustainable management tool. CRISP provides direct support to both the Aleipata

and Safata MPAs in Samoa for consolidation purposes, to FSPI for setting up MPAs in four Pacific Island countries (Kiribati, Solomon Islands, Tuvalu and Vanuatu), and to IFRECOR in French Polynesia, and Wallis and Futuna for setting up and strengthening marine area management plans. MPA support is also being provided to Cook Islands in partnership with WWF. It should also be noted that, as part of its contribution to CRISP, CI is providing financial support for setting up the largest MPA in the world — the Phoenix Island Protected Area Project (PIPA) — in Kiribati.

- Setting up a governance process to integrate coastal management that combines watershed and marine areas. IRD is the main driver behind these projects, which are being pursued on Efate Island, Vanuatu; Vanua Levu, Fiji; and Moorea, French Polynesia.
- Developing appropriate reef restoration techniques for the Pacific through a partnership with a French consultancy firm (Ginger Pacifique) and FSPI, which is setting up pilot sites in Fiji on Motoriki and in Tuvalu on Funafuti Atoll.

Improved understanding of coral ecosystems

CRISP's major focus is on development rather than research, but research is carried out when it can help improve the understanding of:

- coral ecosystem biodiversity;
- how coral ecosystems function, which is essential in developing appropriate and efficient management tools; and
- the nature and renewal mechanisms of, and means of accessing particular ecosystem resources, so as to identify sustainable economic applications for them.

The programme receives support from two world-class scientific advisers: Professor Bernard Salvat of the Ecole Pratique des Hautes Etudes (EPHE), an advanced institute for applied tertiary studies in France, and Dr Clive Wilkinson of the Reef and Rainforest Research Centre in Townsville, Australia. They produced a detailed scientific report during the programme's mid-term review, which took place during the first half of 2008 (Salvat and Wilkinson 2008).

Knowledge and experience dissemination

CRISP aims to integrate sustainable coral reef projects that, although based on Pacific fieldwork, may have regional and possibly, global spin-offs. For this reason, CRISP uses a number of means to disseminate knowledge and experience, including i) involving a large number of programme stakeholders in international symposiums and workshops related to coral reefs; ii) via the Internet, whether through the Pacific Reefbase portal, which is the regional version of the worldwide Reefbase (www.reefbase.org), or the CRISP website, on which documents, particularly those concerning methodological tools developed under the programme, are regularly posted and made available to the general public and professionals; and iii) by developing specific tools on various media (e.g. manuals, CDs and DVDs), and circulating these through different networks.

Coral reef and resource health monitoring

CRISP's focus with respect to reef monitoring are both methodological (developing techniques that are both reliable and user-friendly), and related to using a range of information — both that which focuses on habitat (coral reef) health status, and that linked to associated re-

sources (i.e. food fish and invertebrates). The reef-health monitoring segment is carried out by assisting the Global Coral Reef Monitoring Network (GCRMN), which has two data collection and capitalisation nodes for underwater information gathered from Melanesia and Polynesia, the latter commonly dubbed the "Polynesia Mana". The first node is managed by the University of the South Pacific (in Fiji) and the second by CRILOBE from Moorea; both receive financial support from CRISP earmarked for training and practical monitoring work. The World Fish Center, which oversees implementation of the Reefbase Internet portal, is also a stakeholder in developing the software Coremo (designed to standardise entry of coral reef monitoring data) and posting GCRMN results on line. Applied research into reef fishery management is being implemented by USP and IRD's UR 128 CoreUs research unit. This has led to the identification of indicators to be used for trend charts on reef fisheries resource management in the Pacific. Through recent additional funding from the AFD, SPC will serve as focal point for this activity, which should help to exploit data from the PROCFish project to meet the critical need for management tools that are appropriate for island countries.



Monitoring coral health.



Reef fish postlarvae captured on the reef crest.

What is "PCC"?

PCC stands for postlarvae capture and culture or "grow-out". Postlarvae are a development stage in reef fish and crustaceans prior to their settlement in the lagoon and adulthood. The vast majority of animals start their development cycle with an oceanic phase lasting one to three months, after which hundreds of millions of fish and crustaceans re-enter the lagoon. About one in a million juveniles reaches the adult stage, with most eaten by predators. Using innovative techniques, postlarvae can be caught and raised for sale to three potential markets: i) aquaculture (for food purposes); ii) reseeding into ecosystems (to boost biodiversity and increase fish density for

fishing purposes or viewing by tourists); and iii) the lucrative aquarium market. Despite their impressive numbers, captured specimens account for a very small portion of the larval flow, so this technique has very little impact on the ecosystem when compared to techniques involving the capture of adults, which are potential brood stock. This makes PCC a potentially ecofriendly industry. Material promoting these industries was published using CRISP funding support (Moana Initiative 2007).

Decision-maker and stakeholder awareness

Increasing the awareness of all coral reef conservation stakeholders is a major area for the programme, which provides substantial financial support to SPREP, which has been clearly identified as a leader in this field. Stakeholders vary in nature, meaning the messages and resource materials should be tailored to meet specific needs. Although standard awareness campaigns for the general public are important, issues relating to the coral reef economy also need to be addressed, because audiences such as political leaders and donors are generally more attentive to financial issues than environmental considerations. SPREP is supporting the design of and extension work on MPA social and economic monitoring through a Pacific-adapted package known as SEM-Pasifika, developed in partnership with the US National Oceanic and Atmospheric Administration. The CRISP coordination unit at SPC funds a wide variety of studies (in Vanuatu and Solomon Islands)

designed to demonstrate the economic effectiveness of managed marine areas.

Reef resource marketing

Marketing reef resources is a key (and possibly the most important) programme area. Setting up sustainable industries based on the controlled use of reef resources is the best means of ensuring that CRISP has a substantial and lasting effect. Three areas receive CRISP sup-

port: i) promoting sustainable alternative fishing techniques (particularly methods based on the capture and grow-out of reef fish or crustacean postlarvae – cf insert above); ii) optimising the sharing of any profits derived from the discovery of active marine substances (AMSs) isolated in organisms taken from Pacific coral ecosystems; and iii) ecocertification development support for Pacific hotels contributing tourist-based revenue to their countries.

What are "AMSs"?

Active marine substances (AMSs) are active chemical components that can be isolated in various marine organisms and used for therapeutic purposes. Isolating AMSs is a slow, complex process involving i) harvesting the organisms in situ (mainly seaweed and sponges under CRISP); ii) sorting and identifying them; iii) extracting and screening the substances; and iv) conducting potency assays as part of CRISP (e.g. for potential anti-inflammatory or anti-malarial properties). The use of AMSs on an industrial scale takes many years (12–15) of development after the organisms are harvested. Consequently, in addition to providing support to reef organism harvesting and beneficial use, CRISP also focuses on improving the legal framework in countries that have these resources to ensure that financial benefits are equitably shared, particularly where long lead times apply.

Support to networks, institutional links and partnerships

CRISP's philosophy is based on mobilising existing stakeholders and providing them with the financial means to undertake joint projects and establish partnerships. The objective is important in the Pacific, where the French territories have had limited involvement with their English-speaking neighbours. In addition to overcoming language barriers, CRISP endeavours to promote synergies between institutions, including NGOs, research organisations, technical government agencies and private consultancy firms. This partnership-oriented approach, driven by France, extends to the region's developed countries (Australia and New Zealand in particular, but including Japan and the USA as well). It also involves aid donors, as the CRISP Coordination Unit is tasked with identifying financial partnerships. Being regional in scope, the programme covers both English- and French-speaking countries and territories. CRISP has formal institutional links to Pacific is-

land countries and territories through PREP and SPC. With regard to French territories, IFRECOR's local committees are special programme partners; CRISP acts as a valuable go-between for these committees and the English-speaking world.

Training and institutional strengthening

Training and institutional strengthening are a priority for CRISP, helping to ensure that its activities are sustainable and continue after initial funding has ended. There are two primary aspects:

1. Technical training and institutional strengthening for Pacific Islanders through workshops held as part of the programme, using both dedicated funding and joint funding; and
2. Training for students by favouring exchanges that allow French students to study in English-speaking facilities, in particular the University of the South Pacific (USP), and Pacific Island students to study in French-speaking facilities, usually in metropolitan France.

CONCLUSION

This paper provides a basic overview of CRISP by outlining the main areas in which it is contributing to the Pacific Islands on a regional level. More detailed results can be found in six-monthly progress reports (Clua 2005, 2006, 2007 and 2008) that are available from the CRISP website (www.crisp-online.net), along with many other technical documents.

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