Fisheries Newsletter

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Editorial

The SPC Library and the Marine Resources Division have developed a full text Digital Library which is now available online. This Digital Library will enable users to gain online access to electronic versions (in PDF format) of more than 5000 fisheries and aquaculture-related documents, in French and in English, produced by, for, or in collaboration with SPC. The Digital Library is full text searchable. This new tool was developed for the fisheries administrations of the Pacific Islands countries and territories to improve their access to comprehensive, updated, and high quality information.

Franck Magron, in his feature article on page 38 describes the general process of creating a digital library, whereas the second part shows how to practically use the fisheries digital library. To start using the Digital Library, please visit the following URL: http://www.spc.int/mrd/fishlib.php

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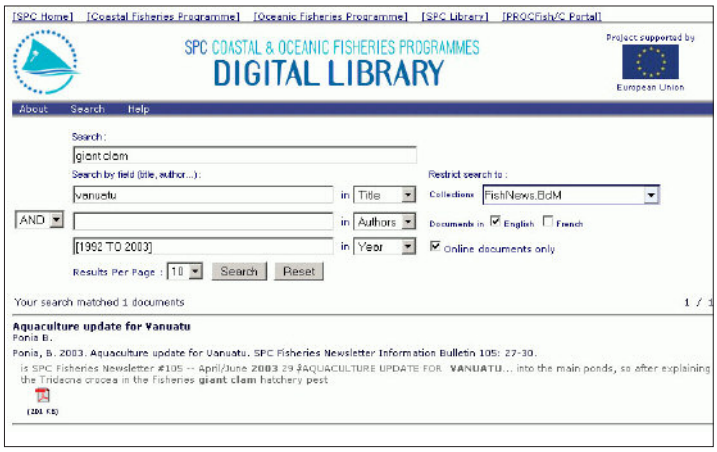

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Web interface on the digital online library
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SECRETARIAT OF THE PACIFIC COMMUNITY
Prepared by the Information Section of the Marine Resources Division and printed with financial assistance from France.

REEF FISHERIES OBSERVATORY

Staff of the coastal component of the EU-funded Pacific Regional Oceanic and Coastal Fisheries Development Programme (PROCFish/C) and the Coastal Fisheries Development Programme (CoFish) conducted recent fieldwork in Fiji Islands and the Republic of the Marshall Islands. In addition, database assistance was provided to the Vanuatu Fisheries Department and a socioeconomic technical manual was finalised.

Fieldwork in Fiji Islands

Socioeconomic surveys were conducted at four sites in Fiji Islands in June/July 2007. These were followup surveys to those conducted by the DemEcoFish and PROCFish/C project in 2002, when different methodologies were used. The followup surveys now use the agreed on methodologies of the PROCFish/C project. The four sites surveyed, Muaivuso and Dromuna on Viti Levu and Mali and Lakeba on Vanua Levu (Fig. 1), were the same sites as previously surveyed. The surveys were undertaken by Aliti Vunisea from PROCFish/C, with assistance from Ratu Nemani Cavuilati, Senior Fisheries Officer at the Fiji Fisheries Department's central office; Apisai Sesewa, Senior Fisheries Officer northern office; and Tavenisa Vereivalu, Research and Aquaculture Officer, northern division. PROCFish/C acknowledges the assistance of the Fiji Fisheries Department, the Provincial Office Northern and the village headmen of Muaivuso, Dromuna, Nakawaga and Lakeba.

Muaivuso

In Muaivuso, 28 out of 60 households were surveyed, and an additional 25 fishers were interviewed. Fishing is a way of life for the community, with 86% of all surveyed households actively involved in reef fisheries. Although the community is in close proximity to Suva, people here live a subsistence lifestyle, with both men and women involved in semi-subsistence fishing activities. Men dominate finfish fishing activities, while women are mainly involved in invertebrate fishing. Nearly half of the surveyed households (49%) relied on fisheries as their primary income source, with 72% of surveyed households relying on fisheries as both primary and secondary income sources. Thus, households in Muaivuso relied significantly on fisheries resources for their social and economic livelihoods. Fish consumption was very high at 107 kg/year with fresh fish consumed an average of four times per week. Invertebrate consumption was low and this was also the case for the consumption of canned fish. All households surveyed consumed fresh fish, and about 86% of households consumed invertebrates, mainly caught by household members.

The main fishing methods used were gillnetting, diving and handlining, with women mainly involved in handlining in the shallower areas of the coastal reefs and lagoon areas. The main distribution outlets for fisheries resources were the Suva and the Lami markets, where women sold finfish and invertebrates weekly. Sea cucumbers, both fresh and processed, were sold directly to exporters, while other invertebrates, such as octopus, sea urchins and spider conch shells were sold at the Suva market weekly. In the last few years, Muaivuso has been the target of fisheries management initiatives with the University of the South Pacific, the association of non-governmental organisations (e.g. the Fiji Locally Managed Marine Area — FLMMA), government departments involved in marine resource management, and the Fiji Fisheries Department, working together with local communities to set up reef reserves in the area. Most of these no-take zones are currently monitored by local communities with the assistance of outside partners. With portions of coastal reef

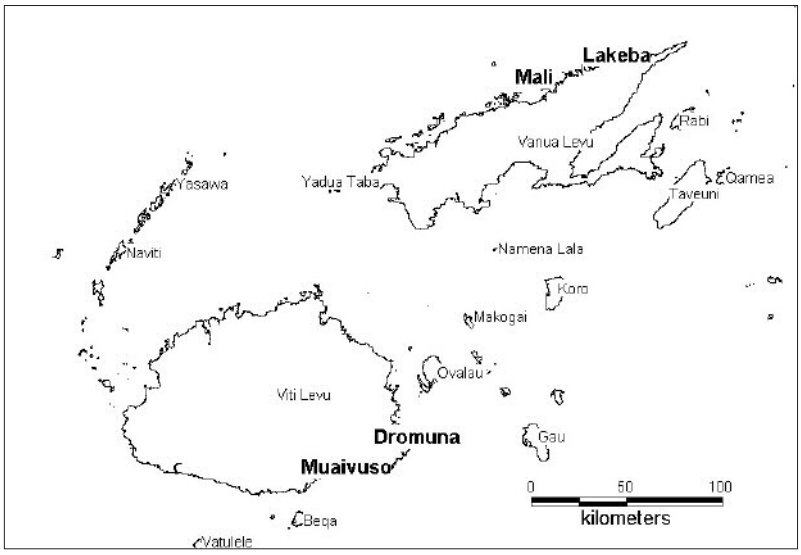


Figure 1: The four survey sites in Fiji Islands.

areas as reserves, people go farther out to fish. Respondents, however, perceived positive changes to fisheries resources, both in availability, sizes and distribution of certain finfish and invertebrate resources since the implementation of management interventions.

Dromuna

In Dromuna, 24 out of 60 households were surveyed, and an additional 15 fishers were interviewed. Dromuna community, which is about 30 minutes by boat from the nearest marketing centre, is one of the main suppliers of both finfish and invertebrates to the Nausori and Suva urban centres. Men dominated the finfish fishery while women were largely involved in invertebrate collection. Women were involved in finfish fishing for commercial purposes generally when they went out on family fishing ventures. Men's participation in the invertebrate fishery was more sporadic, collecting whatever species they came across while finfish fishing. Both men and women collected certain invertebrate species for the commercial market, including species of sea cucumbers and lobsters.

All households in the village were involved in reef fisheries, with 74% of all surveyed households depending on fisheries as their primary source of income, and another 10% of households relying on fisheries as their secondary income source. This indicates the community's high dependence on fisheries resources for their social and economic livelihoods. Per capita consumption of fresh fish was 105 kg/year, while invertebrate and canned fish consumption was very low.

The main fishing methods used were gillnetting and diving in the lagoon and coastal reef areas, while outer reef fishing mostly involved the use of handlines. Most fishers sold their catch to the various distribution outlets, and this included selling to the Fisheries Department Centre, middle sellers, the Nausori and Suva markets, and other smaller outlets. Sea cucumbers, one of the main marine resources collected and sold by both men and women, were sold directly to exporters in Suva. While there was no community level fisheries management initiative in place, respondents were interested in implementing some form of fisheries management, given the community's high rate of dependence on marine resources, high harvest rates, and high incidences of poaching or illegal fishing by outsiders.

Mali

In Nakawaga village on the island of Mali, 16 out of 50 households were surveyed, and an additional 18 fishers were interviewed. Mali, which is only 20 minutes by boat from the Labasa market, is one of the major suppliers of seafood, with village fishermen selling fish almost daily to the market and other distribution outlets. Most of the fishers interviewed were involved in both finfish and invertebrate fisheries. There was a very high dependence on fisheries resources for food and income, with 84% of surveyed households relying on fisheries resources as their primary source of income, with another 10% relying on fisheries as their secondary income source. Fishing was an everyday activity, with 94% of surveyed households actively involved in reef fishing. Per capita consumption of finfish was high at 78 kg/year, but low for invertebrates and canned fish. Men dominated finfish fishing activities, with women mostly involved in invertebrate collection. Men were, however, more involved in the harvesting of invertebrates for commercial purposes, and this included species such as sea cucumbers and lobsters, which were mainly sold to buyers from the Labasa urban centre.

The main fishing methods used were gillnetting within the lagoon and coastal reef areas, diving using spearguns, and handlining, which was mostly done at night in outer reef areas. Women mostly fished within the immediate inshore areas using handlines or accompanying their husbands on fishing trips to outer reef areas.

Management initiatives have been introduced at the provincial level, thus, a major portion of coastal reef areas was under a five-year fishing ban. The community-based management initiatives in place were developed and implemented with the assistance of several international NGOs in collaboration with the Fiji Fisheries Department and communities.

Lakeba

In Lakeba, 25 out of 90 households were surveyed, with an additional 18 fishers interviewed. Lakeba is almost six hours by road to Labasa, the nearest urban centre; therefore, selling finfish and invertebrates to the market is conducted on a weekly basis. Most fishers interviewed were involved in both finfish and invertebrate fisheries. Despite transportation and marketing difficulties, fisheries resources were the primary source of income for the community, with 96% of households stating that fisheries resources were their primary and secondary income sources. Fishing was an everyday activity, with all households actively involved in reef fishing. Men dominated finfish fishing activities, while women were mostly involved in invertebrate collection. Women contributed significantly to household incomes through their regular weekly

sales of invertebrates to the Labasa market. Distribution of finfish was either to middle-sellers that frequented the village, or to the Fisheries Department fish buying centre close to the village.

Fishing was a daily activity with fresh fish consumed on average four times per week. Per capita consumption of fresh fish was 70 kg/year, while consumption of invertebrates was much lower. The main fishing methods used were gillnetting, handlining and spearfishing within the lagoons, coastal and outer reef areas.

Management was initiated and implemented through the assistance of international NGOs in collaboration with FLMMA, the Fisheries Department and communities. A five-year fishing ban in certain reef areas had been implemented at the provincial level and had been in existence for two years. Perceptions from respondents focused largely on the positive changes in finfish and invertebrate sizes, availability and abundance in coastal fishing areas.

Fieldwork and surveys in the Republic of the Marshall Islands

Finfish, invertebrate and socioeconomic surveys were conducted in four locations around the Republic of the Marshall Islands (RMI): Likiep, Ailuk, Arno and Majuro atolls (Fig. 2) during August/September 2007. The sites were selected by staff of the Marshall Islands Marine Resources Authority (MIMRA) in consultation with staff of the CoFish programme. RMI was the 17th country/territory to be surveyed as part of the PROCFish/C and CoFish project.

The PROCFish/C and CoFish team consisted of Kim Friedman, Kalo Pakoa, Emmanuel Tardy and Ferral Lasi (invertebrates); Silvia Pinca, Pierre Boblin and Ribanataake Awira (finfish); and Aliti Vunisea (socioeconomics). The PROCFish/C and CoFish team acknowledges and thanks the following MIMRA staff who assisted and/or worked with the team at one or more locations: Glen Joseph, Director; Florence Edwards, Chief, Coastal fisheries Division; Albon Ishoda, Deputy Chief, Coastal Fisheries Division; Melba White, Emma Kabua, Candis Guavis, and Clyde James, the main CoFish attachments/counterparts for the fieldwork; and Nakamura Reimers and Lee Polin, the skippers, and Boston Levai and Laneo Jacklick the crew, of MIMRA vessels M/V *Laintok* and M/V *Jolok*. Sincere thanks also go to the local governments and communities, represented by Mayor Capelle and the fisheries committee in Likiep; the Honourable Mayor of Ailuk, Madam Cradle Alfred; Junior De Brum, Likiep Fishbase Manager; Joe and Yumiko De Brum on Likiep; Tempo Alfred and Ken Alfred on Ailuk; and boat skippers and helpers Alik Lokeijak, Hermon John, Jackie Jacklick, Jokna Myjena, Caleb Hitchfield, Rice Snight, Aimbi Snight, Junior Alfred, Ricky Ritok, Baiwod Snight, and Jomi Bunglick. The team also acknowledges the assistance rendered by other organisations including the College of the Marshall Islands (CMI) for providing air compressors and lodging facilities; and the National Research Authority (NRAS) for lending their medical kits.

Fieldwork in RMI was conducted in several stages. First, two SPC finfish divers trained two MIMRA divers/counterparts in finfish survey methodologies and fish identification. These four divers then assessed/surveyed the finfish resources in Likiep and Ailuk atolls. The invertebrate team and socioeconomist, along with their counterparts, conducted their work on the atolls at the same time. At the conclusion of this work, there was a changeover of

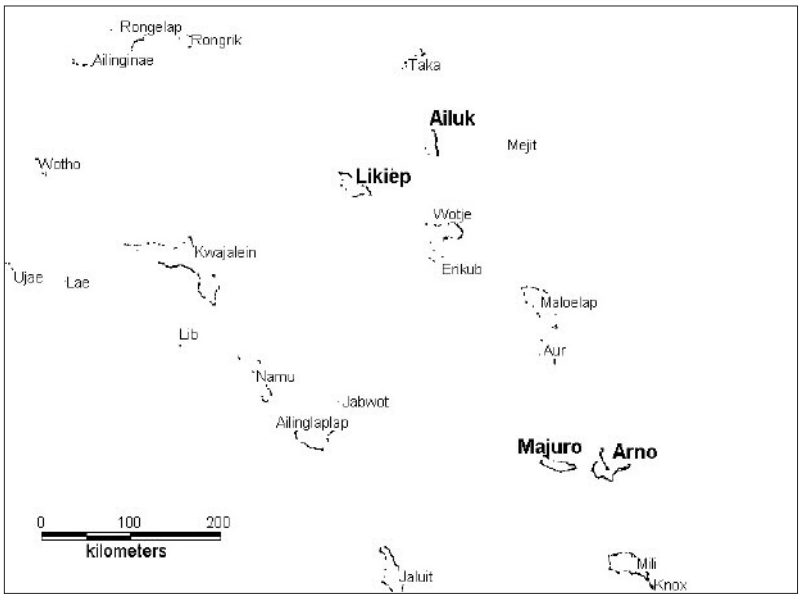
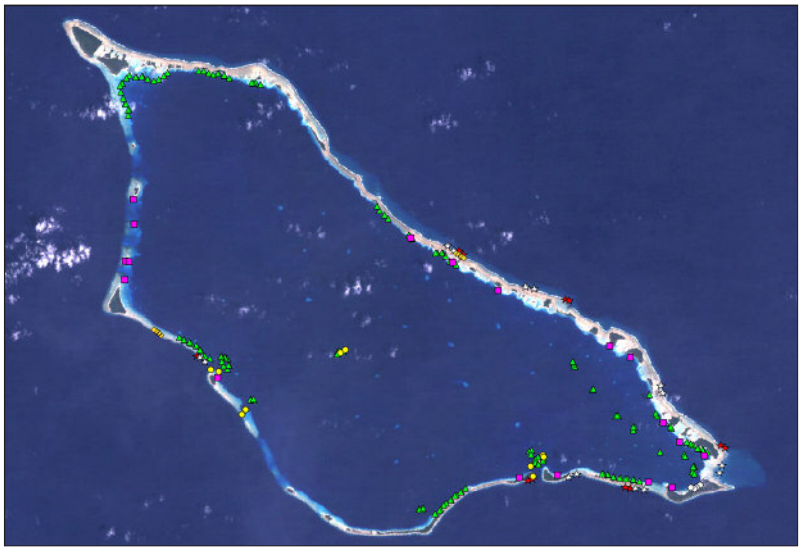


Figure 2: The four survey sites in the Republic of the Marshall Islands.

CoFish staff, with the arrival of a second team. The same two MIMRA finfish counterparts worked with one CoFish finfish diver to conduct finfish surveys at Arno and Majuro atolls, with the invertebrate team and socioeconomist, along with their counterparts, conducting their work at the same time.

Likiep Atoll

Likiep is a large atoll (Fig. 3) located at 9°54'N and 169°08'E. It is 45 km long and 15 km wide, and is oriented along a northwest–southeast axis. Passes are present only in the south. Motus (islets) are scattered along almost all of the barrier reef with fewer found in the northwest. The two main communities live in the southern islands. Three typical habitats, as described by the CoFish finfish protocol (outer reef, back reef and intermediate or lagoon reef), are clearly present at this atoll. The fourth coastal habitat (coastal reef) is missing because the atoll lacks any terrigenous influence. Twenty finfish dive sites were made at Likiep in three of the typical habitats: outer reef, back reef and intermediate reef.



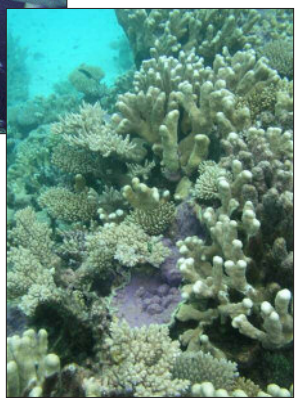


Figure 3 (top): Likiep Atoll, showing some of the survey sites.

Figure 4 (middle): *Caranx sexfasciatus* in a back reef habitat.

Figure 5 (bottom): High coral cover in an intermediate reef habitat.

The outer reef habitat was generally very healthy. The eastern coast could not be sampled due to a lack of passes and rough weather (predominantly coming from the northeast). No exceptional densities or sizes of finfish species were recorded. No *Bolbometopon muricatum* were observed and only very few, small-sized *Cheilinus undulatus* were found in the outer reef area. Back reefs were mainly found in the northern part of the atoll and were very rare anywhere else, and these were, in general, completely covered in sand or detritus. Those that had some living corals had numerous large-sized fish (Fig. 4). The intermediate reefs were essentially represented by large pinnacles with high coral cover (Fig. 5), but their surface area was limited. Fish were quite fearful of divers and were more abundant in the extreme northwestern part of the atoll, far from the main village.

The invertebrate team worked both within the lagoon and on both sides of the barrier reef. Abundance of most invertebrate species was relatively low at Likiep, predominantly due to the poor nutrient profile and exposed nature of the environment, although, fishing activities also had a noticeable effect. In the southern part of the atoll, the exterior reef slope was steeper, and coral life forms were more complex, supporting a wider range of invertebrates in the relatively protected (less exposed) reef.

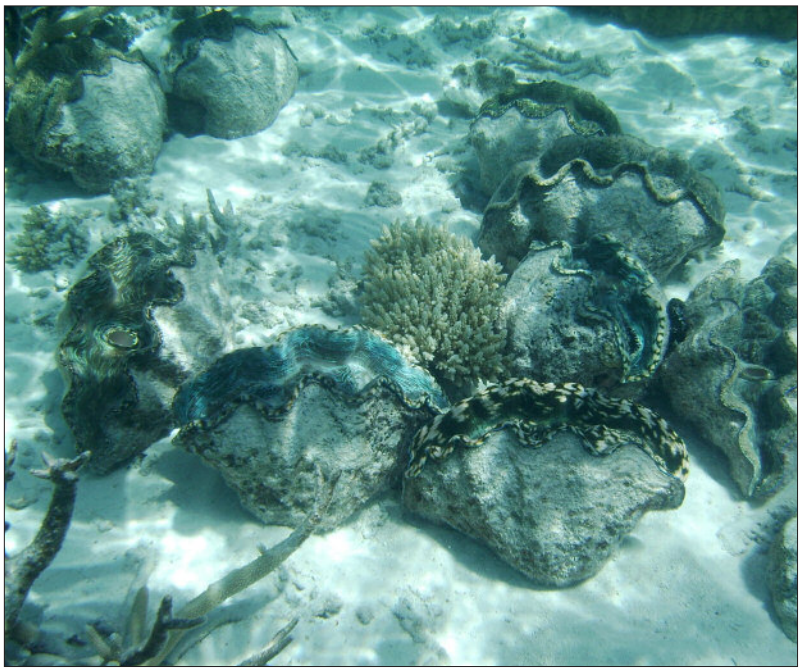
Giant clams were a commonly harvested fishery resource, and *Tridacna maxima* was the most common species recorded. Stocks where relatively healthy, especially those on reefs close to passages where water exchange and movement was greatest. Fishing pressure was noted on reefs near Likiep Island. The fluted clam (*T. squamosa*) and horse-hoof clam (*Hippopus hippopus*), were also recorded. Abundance

of *T. squamosa* was moderate to low, whereas *H. hippopus* was relatively common. In addition, there was a batch of *T. derasa* at MIMRA's aquaculture facility at Likiep. About 5000 juvenile *T. derasa* were introduced 16 years ago (1–2 cm shell length), and now, 150 remain (35–40 cm shell length). *T. derasa* was not recorded outside the nursery during the survey, although the local fisheries officer reported sightings of *T. derasa* juveniles (possibly new recruitments) on reefs to the west of the nursery. The MIMRA Likiep facility produces clams (*T. derasa*, *T. maxima* and *T. squamosa*, Fig. 6) for the aquarium market. The clams are sent to Majuro to be sold to international buyers.

A relic of a much larger population of *T. gigas* still exists at Likiep Atoll. The Likiep survey observed a few medium to large sized individuals around reefs, typically in the west of the atoll, away from the main habitable islands. It is promising to see this giant bivalve present in Likiep, as natural populations are endangered around the Pacific. Some management attention is needed for all clam species at Likiep, especially for rebuilding remnant stocks of *T. gigas*.

The pearl oyster *Pinctada margaritifera* was recorded sporadically at Likiep, and a spat collection trial is underway as part of a study to look at pearl farming prospects in the country. Unfortunately, the commercial top-shell "trochus" (*Trochus niloticus*) is not endemic to the Marshall Islands, and they were not introduced to Likiep in the 1930s. According to local reports, an attempt was made some years ago to seed reefs at Likiep, but this was unsuccessful (Junior De Brum, Likiep Fisheries Officer, pers. comm. 2007). A resurvey of areas where the introductions were made was completed, but these were found to be a non-optimal locations for trochus and none were recorded.

Socioeconomic surveys at Likiep covered 20 out of 80 households, and an additional 22 fishers were interviewed. Community activities were organised around fishing activities, with people still using knowledge of the moon phases, tides and winds when fishing. More than 95% of the surveyed households were actively involved in reef fisheries. Men dominated both finfish fishing and invertebrate collection activities, with women only minimally participating in both activities. Likiep is an isolated atoll, and thus distribution potential for the commercial market is very limited. A fish buying centre was set up on the



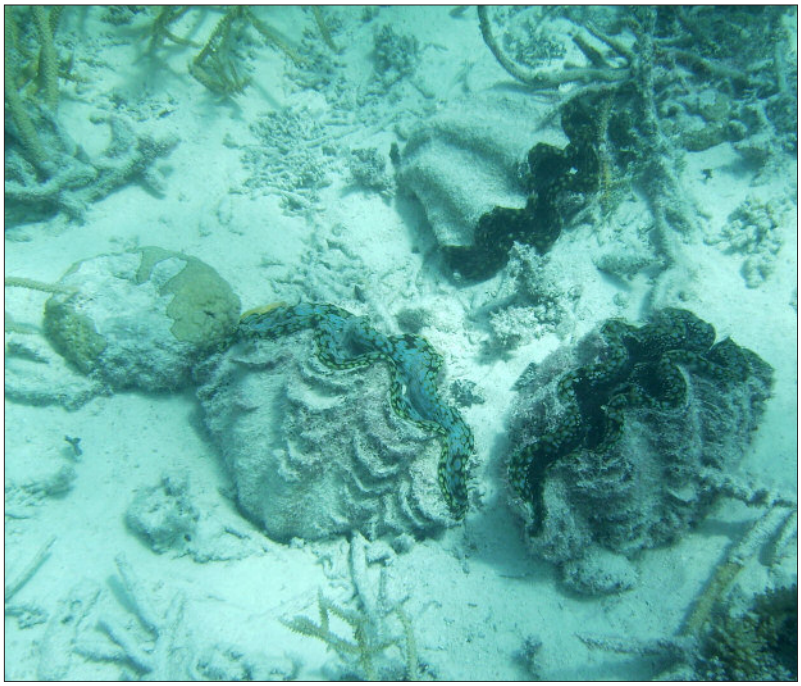


Figure 6: *T. derasa* (top) and *T. squamosa* (bottom) broodstock at the MIMRA clam nursery at Likiep.

atoll by MIMRA, however, difficulties and costs of transporting fresh fish to the urban areas of Majuro and Ebeye have made this activity sporadic. Handicraft sales were the primary income source for 35% of households; these sales were the primary responsibility of women. Fisheries resources were second in terms their importance as an income source, being the primary income source for 20% of households; 40% of households rely on fisheries as their secondary income source. The higher reliance on fisheries resources as a secondary income source mainly involved local selling of dried fish.

Per capita fish consumption was very high at 144 kg/year, with fresh fish consumed around four times per week. Invertebrate consumption was almost negligible, and this was because gleaning and collecting shellfish and other invertebrates was only done during periods of very low tides. Other invertebrates, such as lobsters and coconut crabs, were occasionally harvested and sent by plane to relatives on Majuro or Ebeye. All surveyed households consumed fresh fish and invertebrates, and there was very low consumption of canned fish. This was associated with both the low purchasing power of residents, and their preference for fresh fish.

The main fishing methods practiced included deep-bottom fishing, diving and handlining, with women mainly involved in handlining in lagoon areas. Both fish and fish catches were large, reflecting the abundance of finfish resources. Although some management initiatives exist, they have not been implemented at sites that have been identified as needing some form of protection. With transportation problems and a lack of markets, local fish consumption is high and fishing is done primarily for subsistence purposes.

Ailuk Atoll

Ailuk is an elongated shaped atoll (Fig. 7) that is 30 km long, 13 km wide, and oriented in a north–south direction. It is located at 10°20′N and 169°56′E. The deepest part of the lagoon is about 40 m. Nearly all of the motus are on the eastern side of the atoll. The southernmost motu is inhabited by a community of fishermen who still use sailing or paddling outrigger canoes. The western part of the reef is more submerged and presents four passes, one of which is very wide. Nineteen finfish sites were assessed around the atoll (Fig. 7), covering three of the main habitat types: outer reef, back reef and intermediate reef.

Among the three represented habitats, the outer reefs were by far the most diverse. Outer reefs on the atoll's eastern side could not be surveyed due to bad weather. In general, the outer reef types in the southern and western part were vertical walls. Therefore, the living coral surface area is reduced, although it is very rich and diverse. Fish were quite large and their densities rather high.

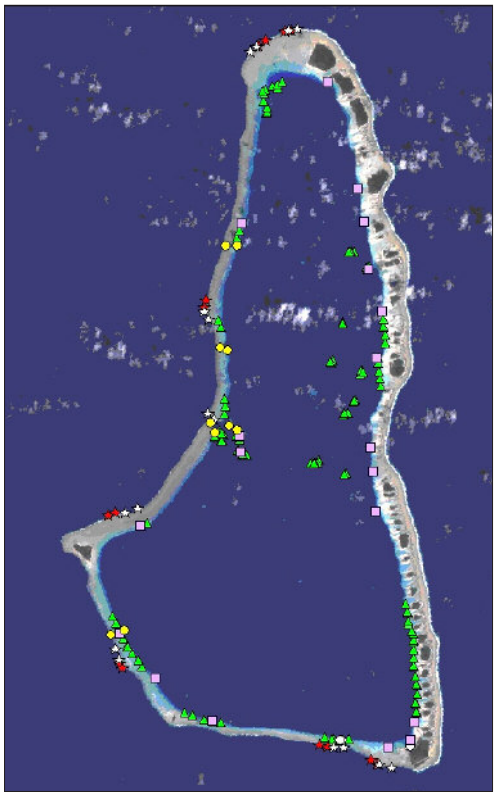


Figure 7 (top): Ailuk Atoll, showing some of the survey sites.

Figure 8 (bottom): *Carcharhinus amblyrhynchos* on outer reef.

However, the team did not record any *Bolbometopon muricatum*, and found few *Cheilinus undulatus* and sharks (Fig. 8).

Back reefs were rather detritic or sandy but surprisingly rich where more corals were present. Corals were alive and healthy even those very close to the surface. Fish were very wary and were of average sizes and densities. Intermediate reefs were generally represented by small patches or pinnacles and were not very abundant. Some were very well built and quite alive (Fig. 9), others are detritic or sandy, and covered in algae (especially *Microdyction*). There were abundant planktophagous fish of good size but in general fish are scared of divers.

Giant clams were a commonly harvested fishery resource. *T. maxima* and the larger clams, *T. squamosa* and *H. hippopus* were recorded, with *H. hippopus* relatively common across the site. *T. gigas* were recorded as dead shells only, especially on the tops of patch reefs.

Sea cucumber resources at Ailuk were generally poor. Commercial species included *Bohadschia argus*, *Holothuria atra*, *H. edulis*, *Thelenota anax* and *T. ananas*. Leopardfish, *B. argus*, found during the surveys had an unusual pattern and colour, with little of the normal spotting that is characteristic for this species (samples have been sent for identification confirmation).

Infaunal species were of little importance at Ailuk, with no extensive shell beds (e.g. *Anadara* or *Strombus luhuanus*) found.

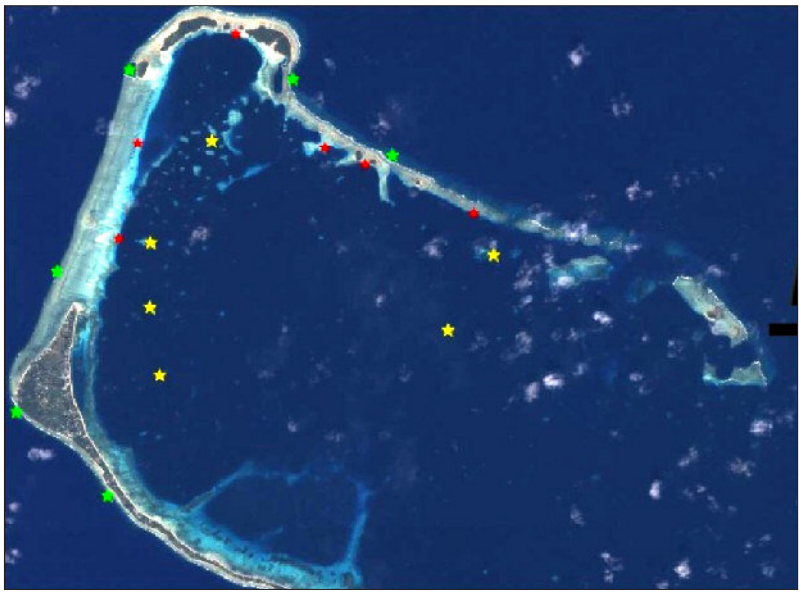


Figure 9 (top): MIMRA trainees Melba White and Emma Kabua on a rich intermediate reef.

Figure 10 (bottom): Finfish dive stations in Laura, western part of Majuro Atoll,

Lobsters, which are not generally targeted in CoFish and PROCFish/C in-water surveys, were uncommon. In surveys targeting other species, lobsters were rarely noted, despite there being an active fishery.

Topshells (or trochus, *Trochus niloticus*) are not endemic to Ailuk, although introductions may have potential because the western reefs are very complex and potentially suitable for supporting this gastropod (with adjacent back reefs suitable for juvenile trochus).

Socioeconomic surveys at Ailuk covered 19 out of 60 households, and an additional 29 fishers were interviewed. Fishing is a way of life for the community, with all surveyed households (100%) actively involved in reef fisheries. Men dominated both finfish fishing and invertebrate collection activities. An outstanding feature of Ailuk was the high use of traditional canoes for fishing and transportation within the lagoon, and the lack of motorised boats.

Handicraft sales were the primary source of income for households because of transportation difficulties and a lack of markets for selling seafood products. Only 10% of households relied on fisheries resources as their primary income source, and another 10% relied on fisheries as their secondary income source. Households, therefore, relied significantly on fisheries resources for basic food needs. Per capita fresh fish consumption was very high at 144 kg/year with fresh fish consumed on average 5.5 times per week. Invertebrate and canned fish consumption was low. All surveyed households consumed fresh fish and invertebrates. Invertebrates such as lobsters, giant clams and coconut crabs were often harvested and sent to relatives by plane.

The main fishing methods used were bottom fishing, diving and handlining, with women occasionally participating in handlining within the shallower areas of the lagoon. Fish were large and abundant in nearshore areas, and the lack of regular commercial fishing activities may explain this. Management interventions have been developed in the community through the assistance of international NGOs and the College of the Marshall Islands in collaboration with MIMRA. Several fishing areas have been identified for consideration for management by the community.

Majuro Atoll – Laura village

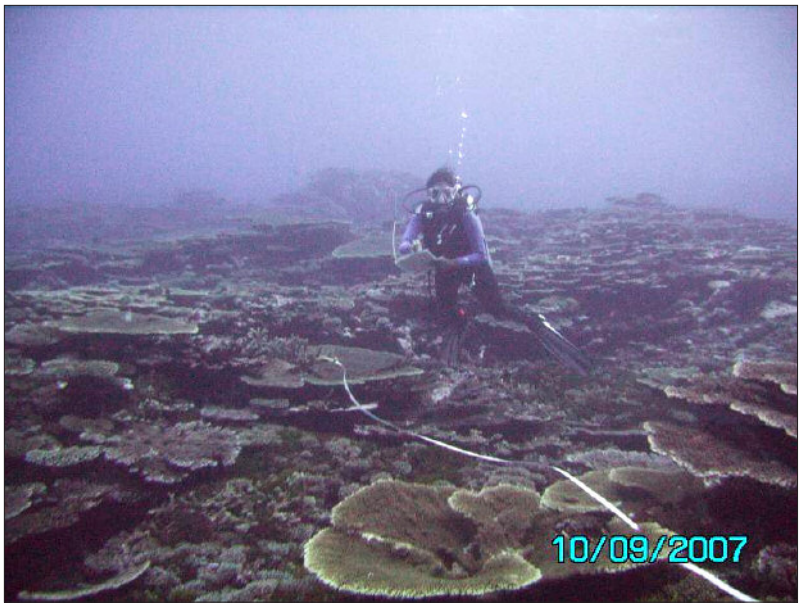
Majuro Atoll (Fig. 10) is about 40 km long and 15 km wide, and is located at 7°10′N and 171°15′E. The deepest part of the lagoon is about 70 m. The atoll's southern part consists of a series of motus (64 in total), with one main bridge over a pass in the reef to connect the main urban areas. Given Majuro Atoll's size, the Laura area to the west was chosen for survey work, with 18 finfish dive stations covering the three habitat types found there: outer reef, back reef and intermediate reef.

The outer reefs had a high diversity of coral species with coverage ranging from 80–100%. Tabulate coral coverage was very high at the second dive station in the north, close to Rongrong Island (Fig. 11). For the remaining stations the massive and submassive corals were dominant with patches of digitate, foliose and branching corals.

Finfish resources in the outer reef system around Laura were dominated by *Chlorurus microrhinos* and *Acanthurus blochii* which were observed in large schools. Large *Cheilinus undulatus* (70–80 cm in length) were also observed at some of the survey stations.

The back reef system around Laura mostly consisted of rubble and sand with little coral coverage (20–30%), and mostly dominated by submassive and massive corals. Finfish populations were mostly dominated by rubble- and sand-associated fish species, such as lethrinids (emperors), mullids (goatfish) and to a lesser extent scarids. Size ranges of fish observed were quite small (15–25 cm). Schools of *Mulloidichthys vanicolensis* were observed in almost all stations along with schools of *Gnathodentex aurolineatus*. Larger fish were quite wary of divers in Laura's back reef system, which might indicate that spearfishing and human disturbances were frequent occurances.

Intermediate reefs showed greater coral coverage (40–60%) compared with back reefs, and were dominated by digitate, submassive, tabulate and



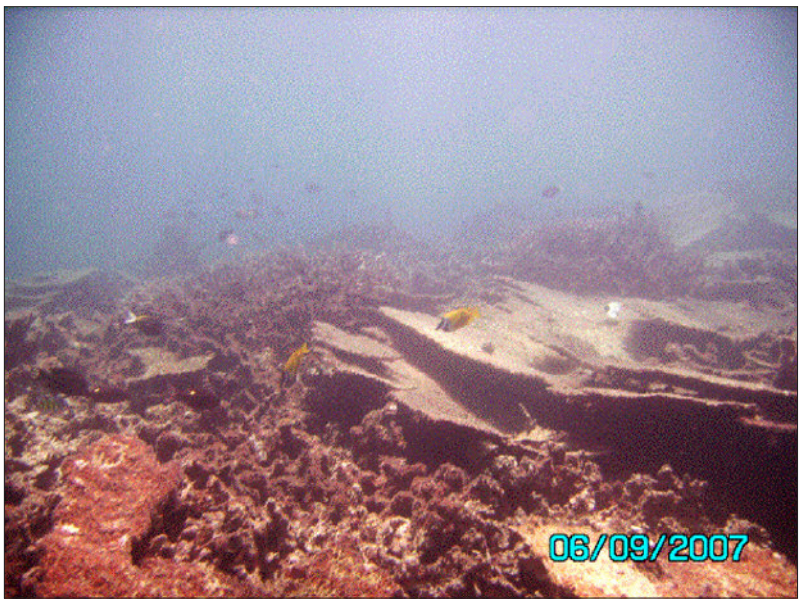


Figure 11 (top): Tabulate corals dominating one site in the outer reef, with counterpart diver Emma Kabua recording data.

Figure 12 (bottom): Dead tabulate coral covered with algae.

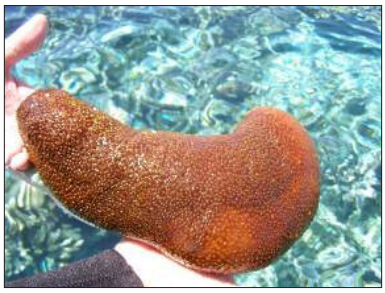


Figure 13 (left): *Epinephelus polyphekadion* in the intermediate reef off Laura.

Figure 14 (right): A species of *Bohadschia* awaiting identification confirmation

branching corals. At a station opposite the main pass, dead table corals covered with algae were observed (Fig. 12), indicating that either a massive bleaching of table corals had occurred, or there had been a heavy storm in the area several years back. Schools of snappers (*Lutjanus gibbus* 20–25 cm) and *L. bohar* (25–30 cm) were observed in great numbers along with juvenile coral trout (*Plectopomus laevis* and *P. areolatus*). A few groupers (*Epinephelus polyphekadion*) were observed at some of the stations (Fig. 13).

Giant clams were a common fishery resource, and *T. maxima*, *T. squamosa* and *H. hippopus* were observed. *H. hippopus* and *T. squamosa* were typically average to large in size, while *T. maxima* tended to be smaller than the mean found in any of the PROCFISH/C countries visited so far. *T. maxima* densities were moderate to low, while *H. hippopus* densities were surprisingly high.

Sea cucumber resources at Laura were generally poor, with only seven commercial species recorded (*Actinopyga mauritiana*, *Bohadschia argus*, *Holothuria atra*, *H. edulis*, *H. nobilis*, *Thelenota ananas* and *T. anax*). Densities of *H. atra* were relatively high, while those of *T. anax* were moderate. All other species were recorded at low to very low densities. Like the northern sites, the leopardfish (*B. argus*) recorded during the surveys had an unusual pattern and colour (Fig. 14), with samples taken and sent for identification confirmation).

Spider shells (*Lambis* spp.), which were commonly harvested, were sporadically found in medium to low densities. Lobsters, which are not generally targeted in CoFish and PROCFish/C in-water surveys, were uncommon, with only one *Panulirus penicillatus* and two *P. versicolor* recorded.

Trochus niloticus were introduced to the Marshall Islands, including Majuro, in the 1930s and were regularly recorded in surveys at Laura, although only in low densities. Nonetheless, several juvenile specimens were recorded in a back reef nursery site, indicating that spawning and recruitment were ongoing.

The survey team were unable to check the windward reef slope of the outer reef. At Majuro, trochus was found in high densities (Clyde James, Aquaculture Specialist with MIMRA, pers comm 2007) on the outer reef of the Amata Kabua international airport, although this area is distant from Laura and outside the CoFish study area. The bivalve *Pinctada margaritifera* was recorded sporadically throughout the site in low densities.

Socioeconomic surveys at Laura covered 24 out of 180 households, with an additional 25 fishers interviewed. Fishing is central to the lifestyle of the people, with 96% of the surveyed households actively involved in reef fisheries. Laura is about one and half hours by road to Majuro's urban centre, thus the community has access to fish distribution outlets in both Laura and Majuro. Because of the community's easy access to Majuro, the main source of income was from paid employment, although a large proportion of the population relied on fisheries resources for their primary and secondary income sources (58%). Men dominated finfish fishing activities, while women were mainly involved in invertebrate collection.

Women's involvement in handicraft production for income generation was similar to the situation in the outer islands. Invertebrate collection was done on very low tides, or during specific seasons, winds and moon phases. Thus, households relied significantly on fisheries resources for their social and economic livelihoods. Per capita fresh fish consumption was very high at 132 kg/year, with fresh fish consumed on average four times per week. All households surveyed consumed fresh fish, while about 83% of households consumed invertebrates. Difficulty in accessing invertebrates and their decreasing numbers were the main reasons given by respondents for why invertebrates were not consumed as frequently as finfish.

The main fishing methods used were gillnetting, diving, bottom fishing and handlining, with women mainly involved in handlining within the shallower areas of the combined coastal

and lagoon areas. Night fishing was more frequent — and more fishing trips were made on a regular basis — at Laura than at of the other survey sites, and this was mostly fishing specifically for commercial purposes. There were no community-based management initiatives in Laura and the open access to the fishing grounds within the Laura area could be the reason for this.

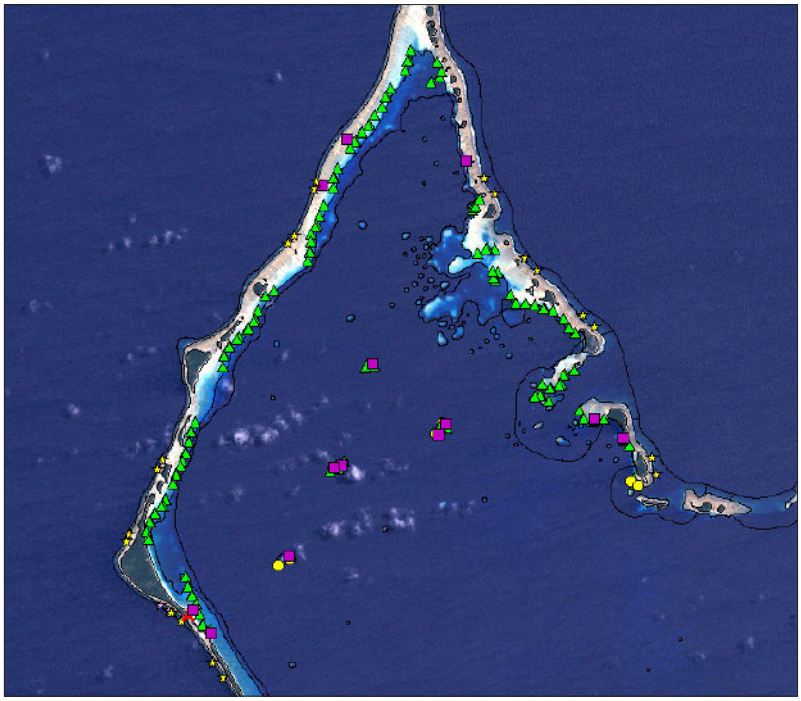
Arno Atoll

Arno Atoll (Fig. 15) — located at 7°05'N and 171°44'E — is a 30-minute boat ride from Majuro. It is L-shaped, and unlike most other atolls, it encloses three different lagoons, a large central one, and two smaller ones to the north and east. The finfish dive stations were selected based on the area targeted by local fishermen. Three main habitat types were covered (outer reef, back reef and intermediate reef), with 6 dive stations for each habitat for a total of 18 transect dives. Invertebrate dive stations were also located in the same areas (Fig. 15).

Coral coverage at the outer reef was very diverse (Fig. 16), with submassive and massive corals dominating all six stations. Coral coverage was high, ranging from 70–80% with patches of branching, tabulate and foliose corals. Fish assemblages were dominated by typical semi-pelagic species, such as rainbow runners (*Elegatis bipinnulata*, Fig. 17), *Chlorurus microrhinos*, *Acanthurus olivaceus* and *Macolor macularis*. Large species of *Cheilinus undulatus* and *Plectropomus laevis* were also observed in high numbers.

Arno's back reefs were mostly covered by rubble, sand and patches of massive, submassive and digitate corals. Fish assemblages were dominated by *Chlorurus microrhinos* (Fig. 18) and *Naso brevirostris*. White tip reef sharks were a common sight at almost all back reef stations on the northeast side of the atoll.

In the lagoon, almost all intermediate reef patches were quite healthy, with coral coverage



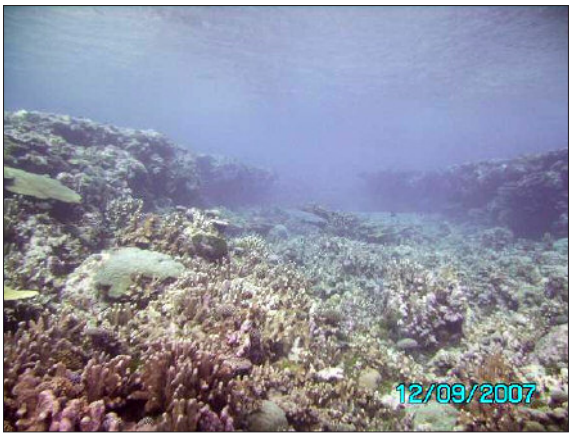


Fig 15 (top): Invertebrate dive stations in Arno
Figure 16 (middle): Corals covering Arno's outer reef.
Figure 17 (bottom): School of *Elegatis bipinnulata* at Arno's outer reef.

ranging from 30–80% and dominated by submassive, massive, digitate and tabulate corals. In some areas, coral coverage was low and the substrate was dominated by turfs and other algae types. The highlight of this habitat were the large schools of *Naso hexacanthus* and *Acanthurus mata* observed (Fig. 19) at nearly every station. Large *Plectropomus laevis* (>70 cm) were also observed at two stations, and juvenile *Cheilinus undulatus* (40–50 cm) were sighted at nearly every station.

At Arno, densities of *Tridacna maxima* were found to be moderate to high in the outer part of the western ocean-facing reefs, but densities were low elsewhere. *Hippopus hippopus* was recorded in moderate densities on the inner part of the northern reef, while elsewhere densities were low to moderate. *T. squamosa* were recorded on only a few occasions.

Sea cucumber resources at Arno were poor, especially in the shallow parts of the lagoon. Only one species, *Thelenota anax* was recorded in good densities during the sea cucumber day survey stations. Six commercial species were recorded (*Actinopyga mauritiana*, *Bohadschia argus*, *Holothuria atra*, *H. fuscogilva*, *Thelenota ananas* and *T. anax*), and mostly in very low densities. Anecdotal reports suggest that sea cucumbers were harvested at Arno in the recent past, and *Stichopus chloronotus* was among the reported species harvested, although our survey did not record a single specimen of this usually common species.

Spider shells, especially *Lambis chiragra*, were found in healthy densities, while other gastropods harvested by local fishermen (e.g. *Turbo argyrostomus*, *Strombus luhuanus* and *Thais* spp.) were found in low densities. No lobsters were recorded anywhere at Arno.

After initial attempts at introduction in the 1930s, the commercial top-shell, *T. niloticus* was again introduced at Arno in 1990, with 200 adult specimens collected from Majuro Atoll. The animals were transplanted onto the reef in front of the Arno fishbase jetty (south coast). During this survey, we found only low densities around the reefs adjacent to the fishbase and their distribution range seemed to be limited to the inner lagoon and western reefs. The northern reefs, however, seem to be a promising site for any future attempt of seeding. A few specimens of the bivalve *Pinctada margaritifera* were also recorded.

Socioeconomic surveys at Arno covered 16 out of 60 households, with an additional 18 fishers interviewed. There is a fish selling centre at Arno, thus there is a ready outlet for commercial fishing activities. Even though they live quite close to Majuro, the people at Arno live a semi-subsistence lifestyle, with a regular commercial fishing venture providing the main means of income generation. About 96% of households were involved in reef fisheries, either for food or for income. Fisheries resources provided 48% of surveyed households with their primary and secondary income sources. Men dominated both finfish and invertebrate collection activities, with women occasionally participating in some fishing and invertebrate collection. Invertebrates were mostly targeted during special seasons, very low tides and special moon phases, and so were not regularly harvested by many of the surveyed households. Per capita fresh fish consumption was 120 kg/year, with fish consumed five times per week. Per capita invertebrate consumption was nearly negligible, with canned fish consumption also low.

The main fishing methods used at Arno were bottom fishing, gillnetting, diving and handlining, with women mainly handlining within the shallower coastal and lagoon areas. The main distribution outlet for fisheries resources was the fish cen-

Figure 18 (top): School of *Chlorurus microrhinos* at Arno's back reef.

Figure 19: Schools of *Naso hexacanthus* (bottom left) and *Acanthurus mata* (bottom right) taking on a dark colour while in schooling mode at an intermediate reef in Arno.

tre at Arno, although many fishers chose to market their own catch in Majuro. Some management work had been initiated at Arno, with some areas identified for marine resource protection.

Database assistance to Vanuatu

In an effort to help national fisheries authorities make use of data collected within countries from markets, logbooks and other sources of information, SPC's Marine Resources Division develops standardised database and software that are distributed in the region. In addition to the standard collection systems, custom databases have been developed by the fisheries authorities to meet their specific needs.

In August, the PROCFish/C's Information and Database Manager, Franck Magron, travelled to Vanuatu to assist the staff of the Fisheries Department to standardise their coastal fisheries access database, by restructuring the tables and writing a set of queries to produce yearly statistics. He also demonstrated from that geolocated data could be plotted on top of bathymetric charts showing the fish catch and effort around seamounts.

Technical manual for socioeconomic surveys

The English version of a technical manual produced by the PROCFish/C and CoFish project titled "Socioeconomic fisheries surveys in Pacific Islands: A manual for the collection of a minimum dataset" by Mecki Kronen, Natasha Stacey, Paula Holland, Franck Magron and Mary Power (Fig. 20) went to the printers in September. This manual was designed in response to the most urgent issues voiced by the fisheries services in the Pacific Island countries and territories covered by the project. The manual targets staff from governmental and non-governmental organisations interested in providing the much needed data baseline, which decision-makers and managers require for the rational management of coastal reef and lagoon resources to ensure their sustainable use for food security, livelihood and economic development.

The manual will be introduced to the region through a series of sub-regional workshops. A workshop announcement has gone out to all 17 participating ACP countries and OCT territories for the nomination of a PROCFish/C-funded participant to one of three training courses. The first two training courses, in English, are scheduled to be held in Noumea, New Caledonia, December 2007 and January 2008. A third training workshop, in French for participants from OCT territories, will also be held in early 2008.

Each workshop will address the following major issues: rationale of socioeconomic fisheries surveys and understanding of a minimum dataset; introduction and familiarisation with the manual, the methods and software; data entry, retrieval and interpretation; discussion of questionnaire surveys, accompanying tools and additional information needed to successfully accomplish a fisheries survey; and extraction of data for further and individual use.

The software package developed by the project's Information and Database Manager will be installed on participants' computers. The training workshop aims at maximising hands-on familiarisation with the method and software developed.

Participants will work on a limited project sample and will also use case studies for presentation and group discussions. The English version of the manual can be downloaded from the project webpage:

http://www.spc.int/coastfish/sections/reef/publications.htm

The French version of the manual should be available by the end of the year.

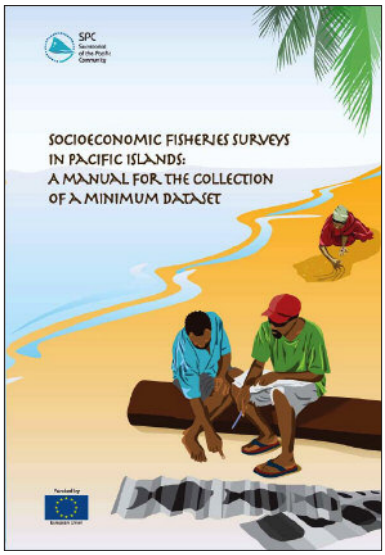


Figure 20: The manual "Socioeconomic fisheries surveys in Pacific Islands: A manual for the collection of a minimum dataset".

FISHERIES MANAGEMENT SECTION

US Coral Reef Task Force meeting in American Samoa

SPC's Coastal Fisheries Management Adviser (CFMA) was invited, on behalf of SPC's Coastal Fisheries Programme, to participate as a panel member and make presentations on three major topics discussed during the meeting of the US Coral Reef Task Force (USCRTF)[1]. The meeting was held in American Samoa from 19–26 August 2007. The following highlights the topics and presentations during the sessions.

1. Exploring opportunities for future regional collaboration with the US Islands Coral Reef Committee. Presentation covered statements of how SPC's Coastal Fisheries Programme can be of assistance to the three US territories (American Samoa, Guam and the Commonwealth of Northern Mariana Islands – CNMI).

2. Translating traditional knowledge into management — Sharing traditional knowledge regionally. Presentation focussed mainly on how communities are empowered to spearhead resource management through the use of community/village fisheries bylaws as a tool for marine conservation and fisheries management.

3. Regional approaches to conserving coral reef ecosystems — Management implications, applications and capacity building opportunities. Presentation was mainly focused on a regional, community ecosystem approach to marine conservation and fisheries management.

Participation and meeting objectives

In addition to its members the meeting attracted over 150 participants mostly from the US federal government, NGOs, US territories and affiliated states, international and regional organisations, and various representatives of American Samoan communities.

From a regional perspective, and the work of SPC's Coastal Fisheries Management Section, the meeting addressed the following objectives:

- Share information on how traditional management could be integrated into new or existing regional networks;
- Discuss opportunities and current needs in sharing information, staff exchange, funding, and engaging communities to support regional efforts;
- Identify effective management tools that other programmes have used that reflect traditional practices;
- The application of the ecological connectivity concept to management;
- Translate the importance of ecological and regional connectivity into community-based resource management approaches;
- How traditional knowledge, management practices and science can be merged to support management on a larger scale;
- Ways of applying the diversity of approaches in the region as key tools to support the ecosystem based management for conservation and sustainable use of nearshore marine resources, particularly coral reef and associated ecosystems;
- Identifying the barriers to effective marine resource management between and among island nations and territories; and
- How to use traditional practices and culture to enhance social, cultural and ecological connectivity.

From SPC's view point the meeting was a success because the Coastal Fisheries Programme worked closely with most, if not all, of the US territories and affiliated members of the USCRTF. Future collaboration with the USCRTF will undoubtedly assist the Coastal Fisheries Management Section not only with sharing knowledge and technical assistance to countries, but co-funding some of the activities in resource management programmes.

[1] The Coral Reef Task Force was established in 1998 through a US presidential executive order. The Task Force comprises 18 members.

Refresher workshop on community-based fisheries management for the two Samoas

American Samoa's Department of Marine and Wildlife Resources (DMWR) established its community-based fisheries management (CBFM) programme in 2001 with technical assistance provided by SPC. The programme is now in need of revising its strategy in dealing with local communities given new developments and improved approaches to involving communities in ecosystem management of inshore fish stocks. The programme has now attracted the participation of 10 village communities since its inception.

Samoa's CBFM programme was established in 1995 through an AusAID-funded Fisheries Extension and Training Project. The project involves a community-focussed extension process, and the development of alternative sources of seafood. The extension process culminates in a fisheries management plan for each participating village. Each plan sets out the resource management and conservation undertakings of the community and the support and undertakings of the Fisheries Division. Over 80 coastal villages have now joined the programme with each village community developing its own fisheries management plan.

Because the two Samoas have similar approaches to implementing their respective programmes, a joint refresher workshop was run in Apia. The workshop was requested by the two Samoas earlier in this year as a means to analyse the performance of each programme, give new staff hands-on training on the facilitation process, provide staff with a basic understanding of CBFMP, and address the ecosystem approach to coastal fisheries management.

At the end of the workshop, programme staff were able to assess their respective programmes, highlighting weaknesses and strengths. A very interesting outcome of the workshop was the attempt by the two programmes to introduce and integrate the ecosystem concept into the current CBFM m.odels. Some participants felt that the ecosystem concept has already been incorporated into current practices, with some pointing out that existing models are ecosystem approaches but go by a different name. The establishment of community fisheries reserves serves not only to increase fish stocks in adjacent areas, but protect the marine ecosystem. All discussions were based on current experiences and lessons learned over the years.

Participants

The refresher programme was attended by 26 participants from Samoa's Division of Environment, Samoa Fisheries Division and American Samoa's DMWR. The Executive Director of DMWR, Afioga Ufagafa Ray Tulafono, and the Assistant Chief Executive Officer Susuga Mulipola A. Mulipola of the Samoa Fisheries, also attended the workshop

The one-week refresher workshop was conducted from 3–7 September.

Left: Susuga Mulipola A. Mulipola (far left) and staff at the refresher workshop in Apia.

Right: Participants at the refresher workshop in Apia. Afioga Ufagafa Ray Tulafono (far left) (DMWR Director) and staff from DMWR.

Preliminary study for the development of management plans for Pohnpei, Federated States of Micronesia

A preliminary assessment of the need for a coastal fisheries management programme was carried out in response to a request from Pohnpei State's Office of Economic Affairs through the Federated State of Micronesia's Department of Foreign Affairs.

The request was mainly for advisory assistance from SPC in developing viable programmes and fisheries management plans that promote the sustainable management and use of coastal fisheries resources. References were made to the following key areas.

- Undertake preliminary study to find out how such management plans may be developed;
- Assess the level of resources available, both at the government and community levels with particular attention to personnel and finance;
- Make recommendations as to how the management of the local pearl industry may be facilitated by local communities;
- Provide assistance for future management of inshore fisheries; and
- Present findings of the preliminary study to local government at the end of the assignment.

The assessment was carried out for two weeks in July. It involved a literature review and consultations with key stakeholders, including meetings with Marine Resources Development staff, NGOs, state government agencies, staff of the Land Grant Programme of the College of Micronesia, municipal authorities, and representatives from the island communities. The State Office of the Attorney General was heavily involved in determining a legal framework necessary for the programme's development.

A draft report was submitted to state authorities and a presentation on major recommendations for programme implementation given to representatives of the municipal governments, Pohnpei state officials, national government, NGOs and the community at the. Activities highlighted in the report will be implemented after comments and endorsement by the state government and relevant authorities.

Upcoming events

Training: Fisheries Statistics and Stock Assessment Phase II, 14–25 January 2008, Apia, Samoa

This training is a follow-up course to Phase I, which was carried out from 27 November–8 December 2006, at the University of the South Pacific (USP) in Suva, Fiji. The course is designed to partially fulfil the needs of national fisheries agencies for training in the use of basic fisheries data in assessing the status of coastal fish stocks. These needs were detailed in the document the "Strategic plan for fisheries management and sustainable coastal fisheries in Pacific Islands" (Strategic Plan). This strategic plan was produced by SPC with funding from the Commonwealth Secretariat (ComSec), FAO, the Western Pacific Regional Fisheries Management Council (WPRFMC) and the Government of France. The document was endorsed at the SPC Heads of Fisheries meeting in August 2003 in Noumea, New Caledonia.

Heads of Fisheries Training on Fisheries Policy and Planning, 28 January–8 February 2008, Apia, Samoa

This is a high level fisheries training course designed to enhance the skills and experiences of heads of fisheries and senior fisheries managers in developing national fisheries policies and project planning that is in line with the goals and objectives to be achieved under national development plans. Achieving such goals and objectives require heads of fisheries and senior fisheries managers, as well as decision-makers to have a clear understanding of the principles of fisheries policy and planning, and the ability to design and implement such policy successfully. Through the provision of this training, senior management staff of PICT fisheries agencies would have the excellent opportunity to improve their understanding of the principles and acquire related skills. The training is to partially fulfil one of the regional training needs requested under the "Strategic plan for fisheries management and sustainable coastal fisheries in Pacific Islands."

Special Session of Heads of Fisheries, 11–13 February 2008, Apia, Samoa

The Special Session of the Heads of Fisheries meeting is to review and endorse the revised

Strategic Plan for fisheries management and sustainable coastal fisheries in the Pacific Islands. The special session is scheduled to coincide with the completion of the training on Fisheries Policy and Planning where all heads of fisheries are also the invited participants.

The need to review the Strategic Plan for fisheries management and sustainable coastal fisheries in the Pacific Islands

During the fifth Heads of Fisheries meeting, held at SPC, Noumea in 2005, SPC was instructed to undertake a comprehensive review of the plan. This is due to changing circumstances as well as the need to better reflect the current needs and priorities of PICTs.

The dynamic nature of fisheries and the ongoing economic and socio-political changes taking place in the region are raising new challenges that affect the relevancy of the plan's focus. Pacific Island heads of fisheries acknowledged that the strategic plan lacks scope and depth, and expressed their strong support for the plan to be reviewed. Based on concerns raised by the Heads of Fisheries participants, the following issues will be incorporated in the review:

- establish fisheries management as pivotal to all domestic fishing operations, whether they be subsistence, artisanal or commercial and accordingly, to pay more attention to the seriousness of the region's coastal fisheries management problems;
- broaden the scope and depth of its coverage beyond purely coastal fisheries management to include research and development, and use the broad ecosystem approach to fisheries to manage environmental impacts on the land and marine environment;
- directly address political directives emanated from Pacific Islands Forum Leaders' decisions that are reflected in regional policy instruments, such as the Pacific Islands Regional Ocean Policy (PIROP), Pacific Islands Ocean Framework for Integrated Strategic Action (PIROF-ISA), the Pacific Plan, and other international policy instruments such as the Millennium Development Goals and Code of Conduct for Responsible Fisheries;
- assign full ownership of the strategic plan to PICTs with the responsibility for its implementation coordinated at a regional basis by SPC; and
- discuss the role of the different sections of SPC's Coastal Fisheries Programme inimplementing this Plan.

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NEARSHORE FISHERIES DEVELOPMENT AND TRAINING SECTION

Longline assistance project in the Cook Islands

Fisheries Development Officer (FDO), Steve Beverly, spent July and August in the Cook Islands — seven weeks in Rarotonga and one week in Aitutaki — helping the domestic longline fleet.

The Rarotonga-based domestic longline fleet, consisting of five operational vessels at the time of this project, was well established but was experiencing difficulties due to rising operating costs, rising freight rate costs for exporting fish, declining catch rates, crew problems, and problems associated with maintaining a fleet of older vessels in a remote location. The owners needed advice on what to do to ameliorate the situation in the short and long term. The fledgling Aitutaki-based fleet — two small boats — was just getting started and needed assistance on vessel layout, gear design and fishing techniques.

At the time of this project, there were 21 licensed Cook Island vessels (not counting the two smaller boats based in Aitutaki), eight of which were based in Rarotonga. Of these, only five were operational. The others had mechanical or crew problems. SPC's Fisheries Development Officer (FDO) Steve Beverly, worked with four of the five operational boats plus the two smaller Aitutaki-based boats. The boats fishing in the northern group were not considered in this project.

Upon arrival in Rarotonga, the FDO met with the Secretary of the Ministry of Marine Resources, Ian Bertram, and the heads of the domestic fishing companies, including Cook Islands Fish, Ltd – Josh Taio, Manager (boats F/V *Ana*, F/V *Lady Mary*), and Landholdings, Ltd – Bill Doherty, Manager (boats F/V *Aulola*, F/V *Bounty*, F/V *Gypsy Trader*).

During the first four weeks of the project, the FDO made four regular trips on the Rarotonga-based boats: *Bounty*, *Aulola*, Ana and *Lady Mary*, in that order (Fig. 1). Details of the five operational boats can be found in Table 1.

Some generalisations can be made about these five boats: all are small- to medium-sized (<18 m), all are older (average age 32 years), and the average fish hold capacity is just around 4 mt. Because of these physical characteristics these boats share some commonalities. They have a very limited range and very limited fishing and fish hold capacities, so the fishing area in which they operate is small compared with the overall EEZ they are fishing within. The result, is a reduction in the amount of effort, compared with medium-size longline boats (>18 m), which are more typical for the fresh tuna and swordfish fisheries. Also, because they are older, these boats will be plagued by maintenance problems. On the other hand, because they are smaller and older, the initial investment to get into the fishery is not as great as it would be for a

Figure 1. F/V *Bounty*

Table 1: Details of Rarotonga's domestic longline fleet.

Boat	LOA (m)	Beam (m)	Depth (m)	GRT	Hull	Year built	Engine (hp)	Fish capacity	License type
Ana	14.7	4.3	1.7	32.8	steel	1970	270	4 mt ice	6 nm
Aulola	11.8	4	1.4	na	steel	1977	109	4 mt ice	12 nm
Bounty	14.4	3.7	1.7	32.8	steel	1970	180	4 mt ice	12 nm
Gypsy Trader	12.8	3.7	1.8	10	steel	1978	130	4 mt ice	6 nm
Lady Mary	16	4.26	1.26	34.8	fibreglass	1982	370	4 mt chilled sea water (CSW)	12 nm

newer, larger boat. An additional advantage is that annual slipping and maintenance can be done in Rarotonga, rather than in Fiji or Tahiti, as would be the case if the boats were larger.

All five of these boats fished more or less the same way during this project. All had monofilament longline systems with ample gear to set around 1000 to 1200 hooks daily, and all of them did shallow night sets using squid and/or sardines for bait and chemical lightsticks. They fished within sight of Rarotonga, from 10–95 km (6–60 mi) for some boats and from 20–100 km (12–60 mi) for other boats, depending on their license. They usually did five sets on each trip, setting around 3000 to 5000 hooks total. Landholding's boats (*Aulola*, *Bounty*, and *Gypsy Trader*) returned to port after three sets to offload fish to Ocean Fresh, the local retail market operated by Landholding, where all of Landholding's fish were sold.

After offloading the fish, they returned to sea for two more sets. Cook Islands Fish's boats (*Ana* and *Lady Mary*) generally stayed at sea for all five sets and fish were either exported or sold directly to Blue Pacific Foods Ltd, another company in Rarotonga. They returned to port on Saturday morning to meet a Rarotonga–Los Angeles flight that departed each Saturday evening. The catch of all five boats during this project consisted mostly of broadbill swordfish with some bigeye tuna, yellowfin tuna, albacore, wahoo and mahi mahi. All fish were landed fresh as gilled and gutted (G&G), headed and gutted (H&G), or fully dressed fish. Both companies subscribed to Orbimage remote sensing charts that show sea surface temperature (SST) and sea surface height (SSH) to enhance fish findings. The captains and crew of the five boats were almost entirely Fijian nationals working in the Cook Islands on work permits, or as resident alien workers. Two Filipinos were also working as crew.

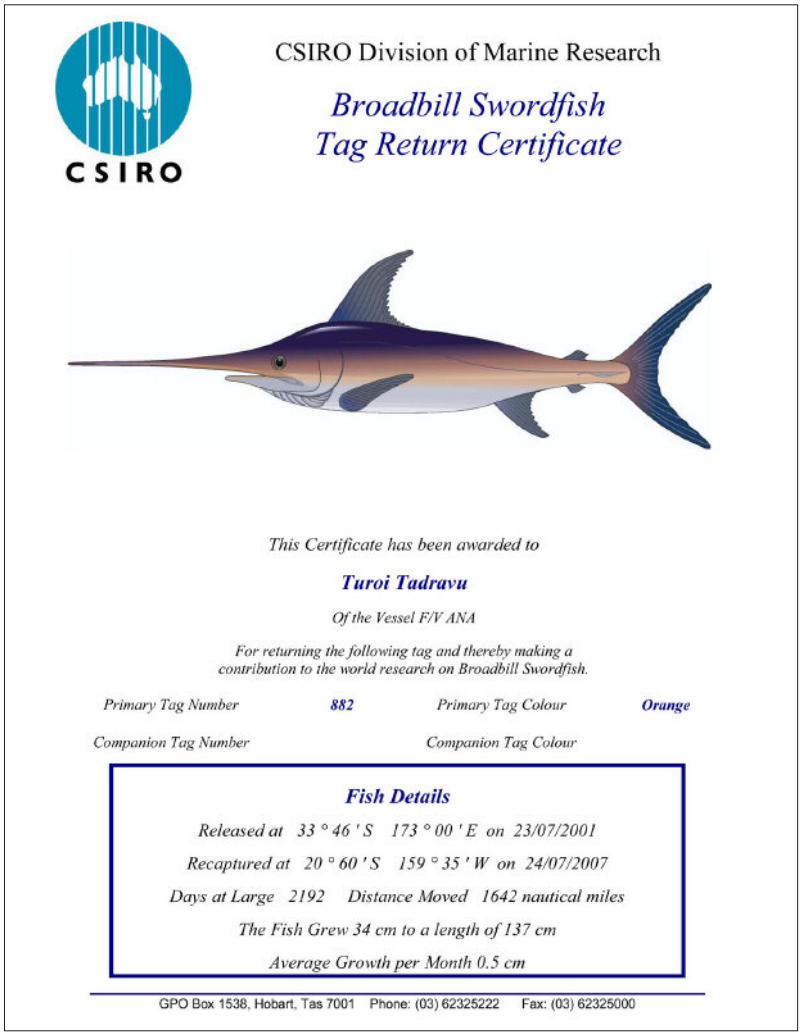
The FDO accompanied the captains and crew on four regular swordfish longline trips during which, 15 sets were made. Catch and effort details can be seen on Table 2. In total, 195 fish were caught, including 40 swordfish, 15 bigeye tuna, 49 albacore, 71 mahi mahi, 2 striped marlin, 5 wahoo, 9 short-billed spearfish, 1 sailfish, 1 yellowfin tuna, and 1 opah. Swordfish comprised about 20% of the catch by numbers but about half by weight and much more than half of the value (estimated) of the total catch. Mahi mahi comprised 36% of the catch and albacore about 25% of the catch by numbers. Bigeye tuna comprised 7% of the catch by numbers but they were generally not of exportable size (i.e. were <30 kg). All other species comprised 12% of the catch by numbers.

On the F/V *Ana* a tagged swordfish was caught. On the same trip a loggerhead turtle was also caught, and the crew got first hand experience in proper turtle handling and release protocols. The loggerhead was released apparently alive and vigorous but with a 3.6 sun Japan tuna hook still lodged in its tongue (Fig. 2). The FDO and crew attempted (without success) to remove the hook and eventually decided that they could do the job but not without killing or seriously injuring the turtle. They also learned about tags. The crew member who first noticed the tag on the swordfish received a certificate and reward from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia (Fig.3). Some good lessons were learned in responsible fishing.

The FDO made one trip on an Aitutaki boat, Baxter Brothers' *Mary J* (Fig. 4). Another boat in Aitutaki, Mike Henry's, Orongo, which wasn't equipped with fishing gear. *Mary J* was equipped with a home-made mini longline reel (made by Clive Baxter) that held enough line for about 200 hooks (Fig. 5). Before departing on *Mary J*, the FDO made floatlines so that a tuna set could be made. The crew had been setting right on the surface, attaching floats directly to the mainline. On the day the FDO arrived in Aitutaki the crew caught 230 kg of mahi mahi on just 180 hooks using this method. They were keen to catch tuna as the local market in Aitutaki was saturated with mahi mahi. One trip was undertaken with the FDO. *Mary J* did one tuna set of 150 hooks just to

Table 2: Catch and effort for 15 observed swordfish sets on Rarotonga-based domestic boats.

Boat	# sets	# hooks	Bait	Number of fish	kg	CPUE (number per 100 hooks	CPUE (kg per 100 hooks
Bounty	3	3500	Sardine/squid	31	725	0.9	22.4
Aulola	3	3600	Sardine/squid	33	600	0.9	17.4
Ana	5	4500	squid	81	1850	1.8	41.1
Lady Mary	4	2800	squid	50	1775	1.8	63.4
Total	15	14,400		195	4950	1.35	34.4



CSIRO Division of Marine Research

Broadbill Swordfish
Tag Return Certificate

CSIRO

This Certificate has been awarded to

Turoi Tadravu

Of the Vessel F/V ANA

For returning the following tag and thereby making a contribution to the world research on Broadbill Swordfish.

Primary Tag Number **882** *Primary Tag Colour* ***Orange***

Companion Tag Number *Companion Tag Colour*

Fish Details

Released at 33 ° 46 ' S 173 ° 00 ' E on 23/07/2001

Recaptured at 20 ° 60 ' S 159 ° 35 ' W on 24/07/2007

Days at Large 2192 Distance Moved 1642 nautical miles

The Fish Grew 34 cm to a length of 137 cm

Average Growth per Month 0.5 cm

GPO Box 1538, Hobart, Tas 7001 Phone: (03) 62325222 Fax: (03) 62325000

Figure 2 (top): Loggerhead turtle being released alive and well from F/V *Ana*.

Figure 3 (bottom): Certificate received from CSIRO for returning a tag from a swordfish.

the west of Aitutaki. Right as hauling started the boat broke down, taking on water in the engine room. The starter was flooded so the main engine would not start. The captain had to call for help.

Fortunately, *Mary J* was equipped with a full complement of safety gear, including a 406 EPIRB. It was also fortunate that the EPIRB did not have to be used. After trying to restart the engine unsuccessfully, the captain gave out a distress call (not a mayday but directly to a land station) as the boat was in no immediate danger of sinking. Even though the engine room continued to take on water, the bilge pump was keeping up. The call was patched through to the owner of the only boat on Aitutaki that could have mounted a search and rescue, Orongo, which set out immediately and eventually found the *Mary J* and took it under tow just as it was getting dark. During the first four hours of the tow, the captain kept in constant radio contact with *Orongo*, directing them how to steer so that the mainline could be hauled. Three young, strong deckhands pulled the entire line by hand. *Mary J* ended up with 12 fish weighing approximately 150 kg (1 opah, 4 yellowfin tuna, and 7 mahi mahi). The boats arrived back at the wharf at around midnight, safe and sound. *Mary J*, however, was out of service for the short term so the FDO returned to Rarotonga. This sea safety incident highlighted the need for continued vigilance and offered good lessons on why it is important to be prepared for any eventuality. Fortunately, the owners of *Mary J* and *Orongo* were very well prepared.

At the conclusion of the project, the FDO presented his findings along with recommendations, in the form of a PowerPoint presentation to MMR and to the vessel owners at a meeting at MMR headquarters.

Figure 4 (left): F/V *Mary J*.

Figure 5 (right): Clive Baxter's home-made mini longline reel.

Faculty of Islands and Oceans offers a new programme in sustainable fisheries

Introduction

The University of the South Pacific's Faculty of Islands and Oceans — through the School of Marine Studies — will be offering a new certificate programme of study in Sustainable Fisheries, beginning the first semester in 2008. The certificate programme is a component of the Sustainable Fisheries Programme, which also includes a diploma and degree in Sustainable Fisheries, which will be offered later. The certificate programme is a full academic year (two semesters) programme, comprising 6 prescribed courses (5 core courses and one elective).

Programme rationale and goals

The programme was initiated subsequent to the approval of the School of Marine Studies' proposal by the regional Head of Fisheries (HOF) meeting in April 2006. The programme was developed in close collaboration and consultation with other faculties and departments of the University of the South Pacific, SPC, national fisheries departments, the Nelson School of Fisheries in New Zealand, and the Commonwealth Secretariat.

The programme was introduced to replace the historical SPC/Nelson Fisheries Officers' course. As such, it is designed to be consistent with the latest SPC/Nelson Fisheries Officers' course programme (2004), which itself was based on recommendations made as part of a comprehensive review of fisheries officers' training needs in the region. The programme will be supported and complemented by a four-week Practical Safety and Fishing course that SPC will continue to run annually. The SPC course may be cross-credited to the certificate in Sustainable Fisheries Programme through the normal USP accreditation procedures.

The programme was developed in recognition of the:

- lack of tertiary training programmes and opportunities in the region for Pacific Island nationals, to enable them to obtain recognised formal tertiary qualifications in the area of sustainable fisheries development and management;
- important role that fisheries play in providing the livelihood and social and economic well being of Pacific Island countries; and
- deteriorating condition of marine resources and the environment in the Pacific Islands, due to the irresponsible use and overexploitation of marine resources, and ineffective management practices.

The School of Marine Studies recognises the need for a long-term solution to national capacity building, and through this programme will:

- promote the concepts and principles of "sustainability" as a basis for fisheries development and management in the region;
- provide appropriate and recognised tertiary training opportunities and qualifications for Pacific Island nationals;
- develop and enhance the capacity of Pacific Island communities or nationals to develop and manage their marine resources and environment in a more responsible and sustainable manner; and

- permit incremental learning, career progression, and professional development in fisheries management.

The principal focus of the programme is the sustainable fisheries or ecosystem approach, which provides a more holistic approach to fisheries development and management in Pacific Island countries. It integrates fisheries, environmental and socioeconomic objectives, and more precautionary approaches in decision-making regarding the use and management of marine resources. In essence, it requires the integration of science and social science, economic, environmental protection and conservation, and national and community participation in decision-making processes relating to the development and management of marine resources.

Programme outcomes

The programme provides students with in-depth knowledge and understanding of:

- The status and challenges of sustainable fisheries development and management in the Pacific Islands;
- The principles of sustainable development and how these can be applied and implemented at the local level to ensure sustainable development and management of marine resources and the environment;
- The marine environment and ecosystem and the important role they play in sustainability of marine resources;
- The role of good governance, communication and extension in sustainable development and management of marine resources;
- The relationship or link between a viable fishing industry, a healthy fish stock, and a healthy environment;
- Fish capture technologies and their impact on marine resources and the environment;
- Aquaculture and post-harvest fisheries and their potential role in sustainable development and management of marine resources; and
- The role of science and social science and their applications in the sustainable development and management of marine resources in the Pacific Islands.

Graduates of this programme should be able to find jobs in the fisheries, maritime, environment and tourism sectors, as well as in nongovernmental organisations and community-based institutions, which are involved in marine resources development, management and conservation.

Programme outline

Level/year: Certificate programme (6 courses only)

Core courses:
- MS112: Introduction to sustainable fisheries;
- MS207: Natural Resources Governance & Extension Tech;
- MS111: Introduction to Marine Science;
- EC 100: Introduction to Economics; and
- BI108: Animal Biology

One of the following:
- MS206: Maritime Techniques;
- MS204: Tropical Seafood;
- IS100: Computing fundamentals;
- GE108: Geographical Techniques;
- MA102: Mathematic for science;
- BI102: Plant Biology

(Or other Courses required Science/Arts perquisites with approval of Head of School)

Scholarship awards

The Commonwealth Secretariat, through USP, will be funding a number of scholarships to enable Commonwealth member countries' candidates to pursue a certificate programme in Sustainable Fisheries at USP. An advertisement on these scholarship awards will be available soon through various Commonwealth Secretariat and USP points of contacts.

Information contact

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Detailed programme information can also be accessed on USP's School of Marine Studies website:

http://www.usp.ac.fj/marine/

DevFish session on tuna fisheries statistics at SPC Heads of Planning and Statistics Meeting

Heads of Statistics and Planning offices from Pacific Island countries and territories, plus representatives of regional and donor agencies, discussed tuna fisheries statistics issues at a special session within the Heads of Planning and Statistics meeting in Noumea, New Caledonia on 21 September 2007.

The Regional Heads of Planning and Heads of Statistics Meeting (HOPS) is organised triennially by SPC. This year's theme was "Future directions for evidence-based decision-making in the Pacific", with particular emphasis on strategic directions for meeting statistical needs and capacity development.

The special fisheries session within the 2007 HOPS meeting was organised by the SPC/DevFish project.

The session included presentations by the staff of the Pacific Islands Forum Fisheries Agency (FFA) and SPC, and experts in fisheries and economic statistics. These presentations covered:

- recent developments in the fisheries industry;
- the importance of adjusting to change in the collection of economic and trade statistics;
- review of the last full regional study on fisheries contributions (by Gillett and Lightfoot in 1999) to gross domestic product (GDP);
- recent DevFish studies on long line and purse seine economics; and
- case studies in statistical compilation from Micronesia.

Participants noted the importance of fisheries in their country's economies, and emphasised the importance of comprehensive data on the economic contribution of fisheries for planning and decision-making, and the need for assistance in generating these data. The smaller countries in particular often struggle to develop and maintain economic statistics in general, and encounter specific difficulties for the fisheries sector.

The meeting welcomed recent efforts by FFA towards developing a set of annual economic indicators and the DevFish studies on purse seine and long-line economics. However, considerably more work is needed to achieve data of sufficient comprehensiveness and quality. Also, it is important that such statistics are updated on an ongoing and timely basis, and not limited to intermittent or one-off studies.

The meeting also noted the potential value of a regionally coordinated approach to fishery economic statistics, including contributions to GDP, exports and other economic data. The benefits of a regional approach could include better use of the SPC/FFA databases on catch volumes as a basis for the economic data series; improvements through accessing the industry knowledge in the regional fisheries organisations; and all countries benefiting from improvements in estimation methods. It could also provide a forum for resolving technical issues, such as determining the economic residency of vessels, and the coverage of fish exports statistics, and help ensure that the fisheries statistics developed are consistent across the region.

The meeting also discussed the best way for this to happen and proposed that an initiative by the DevFish programme to create awareness could be furthered by taking leadership for the potential remedial measure in the immediate future. This proposal was incorporated as a resolution in the final meeting report.

The DevFish project will discuss these suggestions from the HOPS in its next technical planning discussion in November 2007.

Cetacean depredation on commercial tuna longline fishing operations in Fiji

Following a joint in-country request from Fiji's industries and fisheries, the EU-funded DevFish project is commissioning a study to 1) determine which whales are involved in depredation activities with longline vessels, and 2) identify or develop appropriate mitigation measures.

The Fiji longline industry expressed concern about the critical impacts caused by the high incidence of cetacean depredation on fish catches. This same concern was also registered by industry across the region. Preliminary indication by the industry suggests loss of 6–7% of catches in Fijian waters. Logsheet data analysis in Samoa indicates 3–6% of all sets are affected by depredation, with up to 100% of hooked fish removed or damaged beyond saleable quality.

The project is collaborating with the researcher who undertook a similar study in Samoa. The researcher is assisted by a USP student as part of their master's degree programme, and who is under a DevFish scholarship. Fiji fisheries observers are also participating in the project to expand the range of data set collection during their routine trip coverage and also from historical data. Solander Fiji is participating as the industry partner on this research activity and will provide cruises for researchers and access to their company logsheets.

A roundtable meeting for all participants was held at the Fiji Fisheries office on 4–5 October 2007 in Suva. The research process was introduced which guided the formulation of a work programme that identified responsibilities to various party(s). All parties confirmed their general willingness to participate. Fiji observers' participation would basically be through their normal duties and using the current observer forms, which provides for cetacean/depredation recordings.

A DVD showing cetaceans at sea, was used for cetacean ID training and was well received by observers, who noted that the DVD was a very appropriate tool because it showed the movements of cetaceans at sea. This was considered to value add to the SPC ID manual.

This project activity is up and running and we can look forward to a productive research programme over the next 21 months.

"Start Your Fishing Business" training in the Cook Islands, Tonga, Samoa and Kiribati – an update

As you are probably aware from reading our previous articles, SPC, with financial assistance from the Commonwealth Secretariat, is assisting the region with the establishment of a pool of certified trainers in small fishing business planning and management (Start Your Fishing Business programme). This project aims to increase private sector participation in the development of coastal fisheries in PICTs by improving the entrepreneurial skills of existing or prospective small business owners.

The Start Your Fishing Business (SYFB) course and materials, based on the International Labour Organization (ILO) "Start Your Business" model, were initially tailor-made to suit the specific needs of the Papua New Guinea (PNG) artisanal fisheries sector and have been successfully delivered in PNG since 2003. The SYFB training concept was then exported to Solomon Islands and Vanuatu where nationals have been trained to become certified trainers who now deliver these courses to small fisheries business owners.

This year, SPC, the Commonwealth Secretariat, and their counterpart institutions in PNG have worked on expending the network of competent SYFB trainers in four other countries: Cook Islands, Tonga, Samoa and Kiribati. A similar gradual training methodology was used and the initial phase of the project was the delivery of a sub-regional training of trainers (TOT) SYFB course for 12 participants in Apia, Samoa in April 2007 (see SPC *Fisheries Newsletter #121*). After attending the TOT course, and in order to become accredited by ILO as SYFB trainers, the apprentice-trainers are required to deliver one SYFB course to their target audience, under the supervision of master trainers.

As part of the TOT course, participants produced an action plan for the subsequent phases of the project. From mid-July to August 2007, participants to the initial TOT course, except the participant from Kiribati, successfully ran their trial courses in their respective countries. In-country training of entrepreneurs (TOE) workshops were organised as shown on the table below.

This capacity building programme was successfully completed by making possible the accreditation of 11 Pacific Islanders as ILO/SYFB trainers by their supervisors, the PNG-SBDC master trainers.

SPC is keen to further export the SYFB training concept to its other Pacific Island countries. It is envisaged that SPC will continue to seek the Commonwealth Secretariat's financial support for the further extension of the SYFB trainer network in the region.

Country	Workshops	Master Trainers	Date
Tonga	Ha'apai	Brenda Sainol	16–27 July 2007
Tonga	Vava'u	Brenda Sainol	1–14 August 2007
Samoa	Apia	Peter Piawu	16–27 July 2007
Cooks	Cook Islands	Brenda Sainol	20–31 August 2007
Kiribati	Tarawa	Peter Piawu	Postponed to December 2007

Vanuatu Maritime College to host the next SPC "Practical Safety and Fishing course for fisheries officers"

In July 2007, SPC invited applications for participants to the SPC Practical Safety and Fishing Course for fisheries officers, at the Vanuatu Maritime College (VMC) in Santo, Vanuatu. Eleven fisheries officers from nine regional countries (Cook Islands, Nauru, Niue, Palau, PNG, Samoa, Solomon Islands, Tonga, and Wallis and Futuna) will benefit from this training opportunity. Course duration will be four weeks, starting 1 October 2007.

The objective of this course is to provide hands-on training in environmentally and economically sustainable fishing methods to Pacific Island fisheries officers. The training will enable them to assist fishing communities and fishing enterprises in developing sustainable and profitable fishing operations. Areas covered include:

- tuna catching methods (especially small-scale pelagic longlining and mid-water fishing methods),
- basic navigation and seamanship,
- vessel operations and management,
- vessel and crew safety,
- onboard handling and preservation of catch to export standards,
- information on bycatch mitigation,
- small-scale bait fishing gear and methods, and
- deep-water snapper fishing gear and methods.

This course is organised in cooperation with the Vanuatu Maritime College and SPC's Nearshore Fisheries Development and Training Section. During the four-week course, SPC Fisheries Development Officer, William Sokimi, will be in Santo to act as a resource person.

AQUACULTURE SECTION

Vietnam aquaculture study tour
9–11 August 2007

SPC's Aquaculture Adviser was approached by the New Caledonian government to organise a study tour of Vietnam for a delegation from the New Caledonian shrimp farming industry attending the World Aquaculture Society (WAS) Asia-Pacific Aquaculture Conference. The Vietnamese government kindly agreed to this request and a short study tour was organised after the WAS conference. SPC's Aquaculture Adviser and 10 people from New Caledonia participated in the tour.

The main tour organiser was the Vietnam Ministry of Fisheries, Research Institute Aquaculture No 1 (RIA.1). Staff from RIA.1 were seconded to the study tour to act as field guides, drivers and translators.

The tour began outside of Hanoi city at RIA.1 headquarters with a presentation from the institute's director. RIA.1 has 360 staff, of which more than 50 are university graduates who speak English. The institute has a large area with fish ponds and hatcheries for crustaceans and fish, and there is also a feed mill onsite.

Nearby, is the well equipped and staffed Centre for Environment and Disease Monitoring in Aquaculture (CEMA). The centre carries out research and monitoring programmes in water quality, animal health, diseases and genetics. There is also a breeding programme of endemic species that are threatened by extinction.

North of Hanoi in Hai Doung Province, we visited inland freshwater fish and prawn farms. The farms ranged from highly commercialised operations to small household units. Aquaculture is a common livelihood and sufficiently large that some farmers focus only on specific niche opportunities. For example, one entrepreneur who hosted us concentrates on raising fry that he provides to other farmers and this has become a very profitable venture. We also saw village cooperatives with small aquaculture ponds that were integrated with rice paddy fields with a shared irrigation system. Most ponds were farming Nile tilapia but some also had carp species and those farmers who could afford it farmed *Macrobrachium* prawns. One of the village projects we viewed was a small processing facility for smoked tilapia. The smoking provides value-added marketability while improving

the product's shelf life. One recent development was the prolific use of probiotic bacteria in ponds (mostly local species), with anecdotal evidence from farmers that it was improving pond productivity.

The provincial government freshwater seed production facility was a large complex with numerous staff members and live-in dormitories. There was a variety of breeding programmes, including the hybridisation of different tilapia species to produce sterile offspring. The facility is also involved in conservation programmes to restock endangered species such as the giant river carp.

In Quang Ninh Province we visited the provincial fisheries headquarters. There are 80 hectares of ponds onsite with hatcheries for macrobrachium prawn, tilapia and other freshwater fishes such as carp. In the surrounding areas were shrimp farms stocking *Penaeus vannamei* and *P. monodon*. Some farms were very large with their own hatcheries supplying juveniles, and many were operating at intensive levels.

At Hai Phong the RAI.1 organised a boat to visit Halong Bay, which is a World Heritage site renowned for its picturesque rock islands. For several hours we visited small marine finfish cage farms scattered throughout the bay especially with large aggregation of farms close to Cat Ba Islands. We also visited an RAI.1 farm where they hold the finfish broodstock for hatchery breeding. A mix of broodstock were being held, particularly the valuable species of

Top: Finfish farms.

Middle: Marine finfish cage farm – Hai Long Bay.

Bottom: Seed production facility – Hai Doung Province.

groupers for the live reef fish trade but also others such as the fast growing cobia. Many of the fish farm cages also have integrated culture of molluscs such as scallops as well algae. At Cat Ba Island we met the director of a new government hatchery facility. This was a large and modern complex able to cater for fish, molluscs and shrimp species. Technical advisers were being provided by China. It is expected that the facility will be fully commercially self sufficient. Also on Cat Ba Island are other types of aquaculture farms, including a large pearl farm and hatchery.

New mariculture hatchery at Cat Ba Island.

Ten years of pearl farming trials in Kiribati

In 2004, after 10 years of pearl farming development in Kiribati, the first cultured pearls were harvested at Abaiang Atoll. This activity was funded by the Australian Centre for International Agricultural Research (ACIAR) Kiribati black pearl project, and coordinated by James Cook University (JCU) in partnership with the Kiribati Ministry of Fisheries and Marine Resources Development (MFMRD).

At the ACIAR/SPC Black Pearl Culture Workshop held in Tarawa, 9–10 November 2004, a range of economic and management issues were analysed. It was concluded that low market risk products, such as value-added pearl handicrafts, offered a viable economic alternative for I-Kiribati people. Pearl products, such as half-pearl ("mabe"), also offer a low technology and investment opportunity for village-based farmers and local financiers such as the Development Bank of Kiribati. Furthermore, there are prospective markets for these products, such as targeting tourist ocean liner ships that make frequent stops at Fanning Atoll. In 2006, a crop of mabe pearls were harvested through experiments carried at Abaiang Atoll lagoon under the ACIAR/SPC aquaculture mini-project scheme.

Developing new opportunities for pearl shell products

It was proposed that pearls, half pearls and shells accumulated through past project activities should be used in a jewellery workshop supported by ACIAR and SPC funding. As a result, 22 participants were selected by the AMAK (association for women) in Kiribati to attend this week-long event in June 2007.

Overall organisation of the workshop was provided by SPC's Aquaculture Section while JCU provided funding and logistical support on behalf of ACIAR. MFMRD provided local support alongside counterparts from AMAK. The workshop was led by Mr Tere Taio, master carver and manager of Prestige Pearl (Cook Islands), a company that mass produces pearl shell handicrafts.

Top: Cook Islands trainer explaining the use of the tools.

Middle: Trainee displaying a polished shell.

Bottom: Pieces of jewellery produced during the workshop.

Working with pearl shell products is a novelty in Kiribati. The main purpose of this workshop was to train women in pearl shell handicraft and jewellery making. These women will later train others, who in turn will carry out future training. It appeared that all of them gained knowledge during the workshop, all of them are ready to keep working with pearl shells, should there be raw material and equipment available.

Pearl shell jewellery workshop in Kiribati

The workshop was opened at AMAK maneaba in Bikenibeu, South Tarawa. The president of Kiribati, His Excellency the Hon Anote Tong and the first lady, were invited to the opening of the workshop. The Permanent Secretary from the Ministry of Internal and Social Affairs and representatives from The Australian and the Taiwanese high commissions were also present.

On the first day, participants were given a presentation on pearl culture background in Kiribati and encouraged to secure their shells from farmed origin (i.e. Abaiang). Pearls were also displayed as well as mabe (half pearls) that were produced in Abaiang.

Mr Tere Taio introduced participants to the tools used for cleaning, buffing and carving. Participants were taught how to selecting shells and determine shell quality. Most participants practiced shell preparation on the first day, using grinders and sand paper.

On the second day, Mr. Tere Taio described the production and use of mabe (half pearls). These can be of various shapes and used to make pendants, earrings or other pieces of jewelry. Drawing on shells was also demonstrated; whilst cleaning and polishing of shells are

strictly technical protocols, designing items requires artistic skills. Participants were advised to do simple and regular shapes (heart, circles, diamond shape, hook shapes, etc.).

The next day, participants were introduced to the use of the Dremel rotary tool and the various available bits. Four Dremels were available for this workshop. Photos from items produced in the Cook Islands were displayed and this greatly helped inspire the participants.

Cutting and carving mabe was demonstrated and practiced by a some participants as there was a few mabe available for this exercise, however, it was decided that loose 'round' pearls weren't going to be used for this training and will rather be sold as loose pieces of jewelry during marketing trials.

Towards the end of the workshop, around a hundred piece of jewellery were produced by the participants ranging in various shapes and size. Some popular items were:

- Polished shells with Kiribati type carvings on them (e.g. frigate bird, flag, fish)
- Earrings shaped as diamonds, hearts, flowers, teardrops
- Pendants representing animals such as turtles, lizards, frigate birds, fish
- Pendants with regular shapes: heart, hooks, flower;
- Full shell pendants with simple drawings.

At the closing of the workshop, all the items produced by the participants were displayed for the guests. Overall, participants were happy with their work and their new knowledge and guests were enthusiastic about the quality of some of the products.

Conclusions and recommendations

After the five-day workshop, each of the 22 participants gained knowledge and competency in handling and carrying out procedures required to clean and polish shells. They also gained skills in machineries and tools handling. Most importantly, they have the confidence to achieve high standards with finished products. Certain individuals displayed initiatives to move beyond the introductory stage by using different tools to design different work pieces.

It is likely that the technique will be exploited at its best in Kiribati, should raw material and tools be available. It is best to target small handicrafts, making groups or women groups to sustain the technology. Together with the various stakeholders, it was decided that the next step for this project was to further train handicraft making groups within their production sites. For example, a team of two trainers could hold a three- to four-day exclusively practical workshop at, for example, Teitoiningaina (Catholic's women's group) in Taeoraereke (South Tarawa).

Furthermore, a marketing trial will be conducted within the Line Island Group. Finished products could be purchased or produced and exposed for sale when the cruise ships visit Fanning or Christmas atolls. That way, it will be possible to establish how large the potential market is and how many products can be absorbed by tourism in Kiribati.

Grinding the raw shell

SPC Aquaculture Officer participates in forum on sustainable development of Pacific coastal resources

One of the greatest challenges for Pacific Island countries is sustainable development of coastal resources. SPC's Aquaculture Officer, Antoine Teitelbaum, was invited to Australia to present opportunities for developing livelihoods from mariculture.

This seminar was organised with assistance from the Australian and French governments. It was held (3–7 September 2007) in Townsville, Australia, with more than 70 attendees from Australia, France and 13 Pacific Island countries and territories (PICTs). The forum was aimed at examining four key issues: marine protected areas, integrated coastal management, sustainable industries and governance. More than 40 case studies were reported and several success stories were presented as good models for future development of coral reef areas. SPC's Aquaculture Officer contributed by providing two written case studies. The first one on post-larval fish capture and culture techniques that were recently developed in Solomon Islands, and the second one pertaining to the coral trade in Solomon Islands and the way it tends to include more coral mariculture activities. An oral presentation was also given on "Marine ornamentals: From fishing to farming".

The many interesting conclusions and recommendations discussed by representatives of PICTs, included:

- community-based processes for establishing marine protected areas (MPA) in several countries, and scientific proof that these MPAs conserve fish stocks and biodiversity;
- developent of low technology aquaculture activities is providing alternative income sources for isolated communities;
- local authorities have been successful in reducing adverse activities on catchment areas that were damaging reefs downstream (e.g. in Fiji and the Cook Islands); and
- new models of "Pacific way" governance are emerging, incorporating both traditional and modern approaches.

Townsville group

KEEPING SEAFOOD SAFE

This article was written by Chris Leftwich, Chief Inspector at London's wholesale Billingsgate Market, and is reprinted with permission from Seafood Processor. This article is a continuation of the article published in Seafood Processor, April 2007.

Carbon monoxide

With the ever increasing trade in tuna and the desire for purchasers to receive it looking bright red, there was, for a period, a substantial growth in the misuse of carbon monoxide to maintain the original colour of the flesh. The gas is used to combine with the haemoglobin in the fish's blood to maintain the bright pinkish red colour of fresh tuna.

Carbon monoxide allows the colour to be retained even if the fish is exposed to the air, or when it is quite old. Normally, in both instances, the flesh would turn brown alerting potential users to possible problems.

The difficulties created by the use of carbon monoxide are that a product could have high levels of histamine or be way beyond its shelf life and there would be no indication that either problem exists.

Carbon monoxide does not extend the shelf life of the product. Carbon monoxide is a non-permitted additive in the EU, and in many other parts of the world, and is therefore banned from use.

However, there is a development in the US known as Clearsmoke in which carbon monoxide can be present. This process, which uses filtered wood smoke, was approved by the USFDA in 1998.

Allegedly, use of Clearsmoke extends the shelf life of the product without masking the decomposition factors. However, as far as the EU is concerned this is not a permitted process and products treated in this way are banned from importation into the EU.

The European Food Safety Authority is reviewing the process but to date has still not made a decision to allow its use.

Fish poisoning

Although not strictly contaminants, there are two categories of fish which cause fish poisoning that are also banned from importation into Europe. The first is fish from ciguatera endemic areas.

Ciguatera fish poisoning

Incidences of ciguatera are well documented around the world. Toxic algae that live in certain reef areas are the causative agent of ciguatera. Fish that inhabit the reef consume the algae and these are eaten, in turn, by larger predatory fish. The toxin accumulates in the flesh of the fish and anyone unfortunate to eat it ends up with ciguatera fish poisoning.

The symptoms onset quite quickly from a few minutes up to about six hours and can last anything from a few days to several months. Symptoms may include parathesia, blurred vision, pain in the extremities, temperature reversals and respiratory paralysis. Rarely will someone die from the effects, but they can be debilitated for several months.

There has only been one reported case of ciguatera in the UK and this occurred several years ago and was well documented in Lancet as the unfortunate recipients were a doctor and his family.

The types of fish that are implicated are parrotfish, barracudas, moray eels, snappers and groupers. All of these fish, with the exception of moray eels which are completely banned, are regularly imported into Europe, but all from ciguatera free areas. It is illegal to import fish into Europe from ciguatera positive areas.

Puffer fish poisoning

The second group of fish causing fish poisoning are puffer fish. These are the infamous Japanese fugu fish that are considered to be such a delicacy in Japan, where chefs are trained for up to seven years to be able to prepare the fish without causing their clients to be poisoned.

Puffer fish are able to produce their own toxin, which is found in the liver, gonads, blood and intestines. The chefs prepare the fish removing most of the toxin but leaving a small amount in the flesh to enhance the eating sensation.

However, despite the attention to detail, puffer fish have been implicated in several deaths in Japan, presumably due to inexperienced people preparing the fish. These fish are completely banned from importation into Europe, despite protestations from the growing number of Japanese chefs in Europe who would dearly love to import this delicacy.

Microbial contamination

Many microbial contaminants occur occasionally in seafood. However, the two that cause most problems are the salmonellas and vibrios, although of increasing concern is listeria.

Salmonella

This group of bacteria is responsible for the majority of food poisoning cases in the UK, with poultry being the most common source. However, consignments of fishery products are often stopped at entry points into the EU and on analysis were discovered to be contaminated with salmonella.

More than 50% of these cases are attributable to shrimp and most of these would be from farmed shrimp. The reason for this can be attributed in part to the growing methods whereby the water in which they are farmed is contaminated with bacteria from animal sources, and in part to the fact that salmonella grows quite naturally in waters in many of the tropical climates. In addition, there are also problems that can occur by cross-contamination during processing and packing.

If discovered, the particular consignment will be refused entry and the next 10 consignments from that source will be checked. If further consignments are discovered to be similarly affected, the EU will take appropriate action to ensure that this does not continue.

It is perhaps unfortunate for developing countries that the EU takes such a hard line, particularly when domestic poultry is almost always affected. Yet no authority bans poultry from being consumed. In the case of poultry the public are informed of the risks and urged to cook the product carefully thereby ensuring destruction of any bacteria.

Many developing countries have lobbied the EU to allow a more lenient approach to be adopted and suggested that a similar approach to that of domestic poultry be undertaken for imported shrimp. Unfortunately, the EU remains unmoved

Vibrios

There are three major vibrios that are of concern, parahaemolyticus, vulnificus and cholera, and all three can be found in raw seafood in any sub-tropical country.

Parahaemolyticus causes nausea, vomiting and diarrhoea approximately 12–24 hours after consumption of raw and ready-to-eat seafood. Fortunately, the symptoms subside within 2–3 days and the patient should make a full recovery.

Vulnificus is much more problematic in that there are often no early warning signs. But the vibrio attacks the immune system and liver, sometimes with fatal consequences.

Cholera causes an acute intestinal disease and onsets within a few hours to five days causing the sufferer to dehydrate very rapidly. If sufferers remain untreated there is a fatality rate of up to 50%.

This can be a problem in wild and farmed shrimp, and even freshwater fish have been known to be carriers.

Listeria

There are many different strains of listeria, but the most dangerous is *Listeria monocytogenes*. However, discovery of any strain is indicative that *L. monocytogenes* could be present and the product would be rejected.

Listeria can be found in many seafood products as it is a salt tolerant bacterium, and is of particular concern in smoked fish where it can survive the cold smoking process. It has an incubation period of one to 90 days with an average of about 30.

In healthy adults, listeria can cause mild infections of the eyes and skin, and also gastro-enteritis, but in more severe cases it could lead to blood poisoning (septicaemia) or meningitis. But it is of most concern to pregnant women. In the expectant mother it can cause mild flu-like symptoms, but can have catastrophic consequences to the unborn infant where it can cause premature deliveries, still birth or severe illness.

Source: Seafood Processor, May 2007, pp 12–13. (http://www.seafoodprocessor.com/heighway/home.htm?site=sfp)

POSTLARVAL FISH CAPTURE AND GROW-OUT MANUAL

*by Cathy Hair**

A new manual describing how to catch and rear postlarval fish and crustaceans for the marine aquarium trade has been published by the Australian Centre for International Agricultural Research (ACIAR). It is the culmination of a five-year study funded by ACIAR and conducted by the WorldFish Center in Solomon Islands on postlarval capture and culture (PCC). The initial four years of research (1999–2002) demonstrated the potential to use environmentally friendly methods to capture and culture a range of fish and crustaceans as they settled from the plankton. A final year (2003) allowed the project team to fine-tune the simple aquaculture techniques required to grow them out to market size.

Many coral reef species sought after in the aquarium trade were collected as postlarvae and reared for sale, with sufficient value to sustain a profitable fishery. Not all species on the aquarium fish list are currently included in the PCC fishery, however, as only the most valuable warrant the effort to catch, grow-out and sell. In particular, cleaner shrimp, lobster and a few high-end fish species, such

Top: WorldFish Center PCC trainer, Regon Warren, demonstrating operation of the crest net and codend.

Middle: WorldFish Center PCC trainer, Ambo Tewaki, constructing a fish-holding cage with workshop participants.

Bottom: Workshop participants sorting the postlarval catch from a crest net deployed overnight on Nusa Nane reef near Gizo, Western Province, Solomon Islands.

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as angelfish, received good farm-gate prices from the local exporter. We hope that the range and demand will expand as the environmental benefits associated with this fishery are recognised and rewarded, a goal that organisations such as the Marine Aquarium Council are working towards.

In 2004, soon after the conclusion of the research, the first batch of potential farmers was trained at an ACIAR-funded workshop in Gizo. A draft manual was used to assist in this process. Feedback on the usefulness of the manual was sought from workshop participants. Using this as the base, the next step was to decide on the content and format for a manual that would be appropriate for the target audience of PCC farmers. Following the release of the "Seaweed Farming in Kiribati" booklet, it was agreed that this cartoon style format was an ideal approach, being easy and fun to read, without any sacrifice of educational value.

The Kiribati Seaweed booklet was the model but the PCC manual has a definite Solomon flavour. The booklet was designed at the WorldFish aquaculture station at Nusa Tupe by Cathy Hair, Regon Warren, Ambo Tewaki and Ronnie Posala. A local artist, Kisi Mae, provided the wonderful illustrations. The format differs also from the other in that it has more text, necessary because of the more complex nature of the PCC techniques. Decisions on the manual's content arose out of consultations with the WorldFish staff responsible for PCC research and extension activities, with valuable input from a successful PCC farmer. The ACIAR publications team also contributed to the final product.

The manual is divided into four sections. The Introduction explains what this new fishery is all about and who it is suitable for; the Capture section explains how to make, set and catch fish with the collection gear; the Grow-out section deals with fish retrieval, handling and husbandry aspects of the fishery; and the Export section shows how to tell when the fish and crustaceans are ready for export and how to get them to market in good condition with the lowest possible mortality. The manual focuses on a sustainable and responsible approach to harvesting the postlarval resource. We emphasise looking after the catch all the way from the sea to the exporter because this makes sense for the environment and the farmer's pocket.

The manual is available to anyone who is interested in learning about this new fishery, although some kind of hands-on training is recommended before developing a PCC fishery. For a copy of the manual and more information, contact:

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WorldFish Center, Nusa Tupe,
PO Box 77, Gizo, Western Province,
Solomon Islands,
Ph: +677 60022, Fax: +677 60534,
email: c.oengpepa@cgiar.org

Antoine Teitelbaum,
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SPC, BP D5, 98848, Noumea Cedex,
New Caledonia
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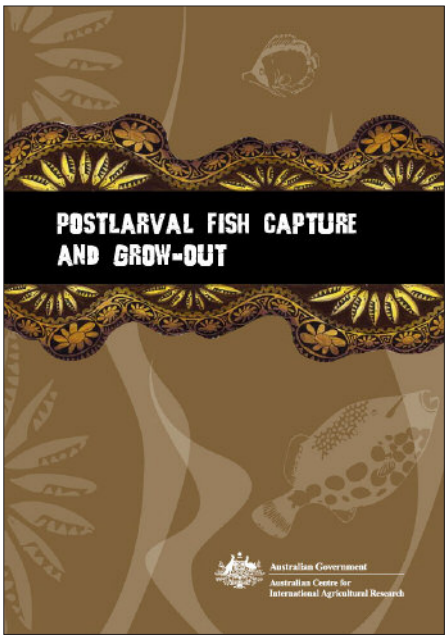

FISH – A CORNERSTONE OF FUTURE FOOD SECURITY FOR THE PACIFIC

*by Johann Bell**

Maslow has helped us understand that development rarely takes place until people's basic needs — food, shelter and security — have been met**. This lesson must be taken to heart in the Pacific — plans to improve health and education, provide jobs and manage natural resources have to be underpinned by access to nutritious food for all.

This is no easy task. Pacific Island populations are growing rapidly and careful planning is needed to identify how best to provide the food required.

Four programmes at the Secretariat of the Pacific Community (SPC) have joined forces to help Pacific Island countries and territories (PICTs) meet this challenge — Public Health, Statistics and Demography, Coastal Fisheries and Oceanic Fisheries (www.spc.int). The conclusion is that much of the answer lies with fish.

The SPC team identified how much fish should be eaten for a healthy diet, how much fish is being eaten in the region now, and how much fish will be needed for food security in the region in 2030.

The results confirm that the Pacific is still extraordinarily dependent on fish. In many PICTs, fish makes up 70–90% of total animal protein intake. Other important findings were that most of the fish used for food comes from subsistence fishing, and that fish consumption in most PICTs well exceeds the level required for good nutrition (i.e. an average of 35 kg per person per year). The large inland populations of Papua New Guinea are a notable exception — their consumption of fish is meagre due to limited access.

The good news is that Pacific islanders are eating plenty of fish. The reality is that they have few alternative sources of animal protein. The challenge for national planners, therefore, is to ensure that growing populations continue to have physical, social and economic access to the fish they need. In rural areas, fish needs to be made available in ways that enable households to catch or produce it for themselves. In urban centres, it needs to be supplied at affordable prices.

The amount of fish needed by the region in 2030 will be much greater than most people realise (see figure). Another sobering realisation is that even well-managed coastal fisheries cannot produce the fish required. Preliminary analysis shows a huge shortfall between the needs for fish in 2030 and estimated sustainable production from coastal fisheries for 13 of the 22 PICTs. Solomon Islands is a case in point. Sustainable production from the nation's coastal fisheries is not known accurately, but is likely to be in the range of 5000–10,000 tonnes per year. This falls far below the 30,000 tonnes of fish the country will need for food security in 2030.

There is consensus that no further increases in coastal fisheries production are possible for many PICTs, so where will the additional fish come from? Improved access to tuna by rural communities is part of the solution, as is small pond aquaculture. There is more than enough tuna to feed the people of the Pacific for decades to come and, with careful planning and management, the large surplus can continue to be used to contribute to national economies through export-orientated domestic industries and sale of access rights to distant water fishing nations. Distributing the proportion of tuna required for food security to rural communities is the challenge.

A joint project between SPC and NZAID has provided a way forward. The project team modified the design of the moored fish aggregating devices (FADs), commonly used in the region since the early 1980s, to reduce their cost and extend their lifespan. These low-cost moored FADs, designed for inshore waters, are suitable for use by coastal fishing communities. They can be placed close enough to shore so that villagers can paddle to them in canoes, or further offshore where communities can afford to operate skiffs. The FADs aggregate tuna and other large pelagic fish and promise to greatly increase production from subsistence fisheries. Their potential has been confirmed through trials in Niue and Cook Islands, where the gross value of fish harvested exceeded the cost of the FADs by three- to seven-fold.

Nauru is also benefiting from new designs for inshore FADs. The Nearshore Fisheries Development and Training Section at SPC recently helped the Nauru Fisheries and Marine Resources Authority (NFMRA) to deploy seven simple inshore FADs with-

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** See Maslow's Hierarchy of Needs at http://en.wikipedia.org/wiki/Maslow's_hierarchy_of_needs

in 500 m of the coast. These FADs, funded by Taiwan/ROC, have innovative mooring systems, using grapnels instead of concrete blocks, and can be deployed from small vessels. SPC also trained local fishermen in mid-water fishing methods and arranged for an Australian boat builder based in Kiribati to teach local fishermen to construct canoes using modern materials and tools. These canoes are suitable for fishing around FADs in reasonable weather.

Charleston Deiye, CEO of NFMRA, reports that all FADs are yielding fish and three have large mixed schools of rainbow runner, skipjack, frigate mackerel, yellowfin tuna and wahoo. 'Our fishermen all know the importance of FADs and are very attentive to keeping them in place and making suggestions about improvements,' he said.

Mr Deiye will join staff from SPC and the Forum Fisheries Agency at this year's Conference of the Pacific Community in Apia to make presentations during the special theme on "The future of Pacific fisheries — planning and managing for food security, sustainable livelihoods and economic growth"

http://www.spc.int/AC/conf_V_theme.htm)

The theme will not only help PICTs find ways to maximise the contribution of tuna to economic growth, it will also focus on planning the use of fish for food security.

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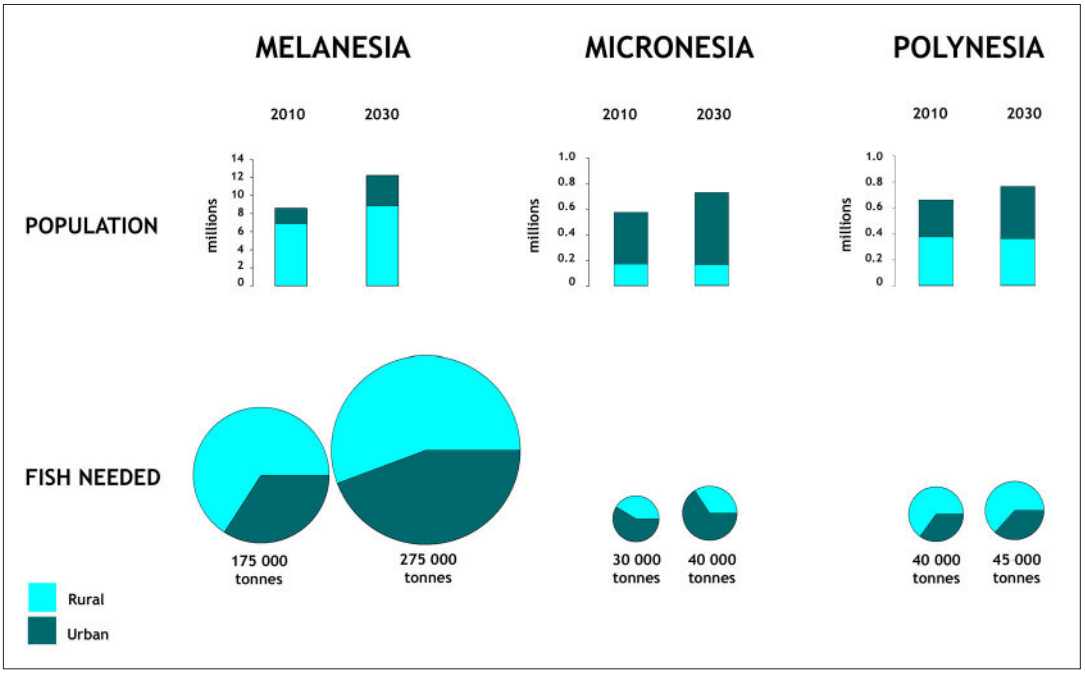

Forecasts of population growth, and the fish needed for food security, for rural and urban areas in the Pacific. (Estimates of fish needed by Melanesia are based on an average annual consumption of 35 kg per person per year, except for inland Papua New Guinea. Estimates for Micronesia and Polynesia are based on current rates of per capita fish consumption.)

THE COLLECTED WORKS OF R.E. JOHANNES AVAILABLE

Robert Johannes' publications on marine traditional knowledge and management (2007) are available for immediate purchase in downloadable, CD and hardcopy versions from the International Resources Management Institute's website.

Robert Johannes was a tropical marine ecologist who, beginning in the mid-1970s, pioneered the idea of integrating the specialised ecological knowledge and traditional marine resource management systems of Pacific Island communities with Western concepts of scientific management for the purposes of resource conservation. In so doing, he highlighted the importance of indigenous knowledge and community-based systems as key factors in marine conservation.

Aware that the rapid disappearance of traditional knowledge

and the lack of interest of younger people in acquiring this knowledge was a serious constraint to implementing his approach, Johannes sought to create a widespread awareness of this often encyclopedic knowledge base. He advocated a reawakening of traditional environmental ethics among youth and hereditary chiefs related to their exclusive reef and lagoon tenure, an ancient form of marine protection which, he contended, provides a practical and time-tested model of "limited entry" that Western fisheries biologists and economists were only then hitting on as an innovative way to manage their own fisheries.

The International Resources Management Institute has reprinted, in chronological order, 24 of Robert Johannes' contributions about marine traditional knowledge and management that extend the ideas he expressed in his renowned book, Words of the Lagoon. To purchase the collected works, visit:

http://www.intresmanins.com/publications.html

ORGANIZATION SEEKS MANUSCRIPTS DEALING WITH FISHERIES AND COASTAL MARINE ISSUES

The International Resources Management Institute (IRMI) is a Hong Kong-based research and consulting organization that is soliciting manuscripts pertaining to fisheries and coastal marine issues.

IRMI focuses on the Asia-Pacific region and on fisheries and development problems in coastal marine communities and environments. Manuscripts focusing on other regions and topics will also be considered for publication. IRMI has established a website to make publications available electronically and at low cost.

IRMI is especially interested in handling items that more conventional publishers would likely reject as being of very limited appeal, and so either not economically viable, or viable only if sold only at astronomical prices. Such writings would include highly specialised monographs (particularly from tropical countries), collected works, conference proceedings, festschriften, and items with a large number of colored photographs. In particular, IRMI encourages inquiries from younger authors at institutions in countries where there are few publications outlets and opportunities.

So far, publications have been kept inexpensive, and sold just to recover expenses. In keeping with that objective, IRMI prefers to produce downloadable versions. However, CD and printed versions are also produced, especially for institutional libraries. Printed versions are made on demand, and distributed unbound. Besides allowing libraries or individuals to bind them to suit their own needs, this greatly reduces total costs, because binding and storage costs are eliminated. This contributes to keeping the price of publications reasonable.

IRMI's main objective has been to provide publications within the reach of relatively low income individuals and institutions. For that reason a modest publications subsidy is requested from authors who are in a position to provide one. Subsidies are used solely to defray unavoidable expenses, and so to keep sales prices as low as possible.

For that reason, too, IRMI encourages communication by email. If you wish to learn more, please go to:

http://www.intresmanins.com/

You can use the "Feedback Form" for any inquiries or comments. When doing so, make sure to write "Publication Inquiry" in the subject line. Like all of us, IRMI suffers from spam abuse.

SPC COASTAL AND OCEANIC FISHERIES DIGITAL LIBRARY

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The Secretariat of the Pacific Community (SPC) has been involved in marine resource management since its creation, 60 years ago. Since then, thousands of papers and reports have been produced by, for, or in collaboration with SPC, and have been archived over the years by SPC's library.

These documents are invaluable for retracing past records of marine resource exploitation in the Pacific Islands region, providing information that is no longer available anywhere else; for example, commodity export figures for the 1920s and 1930s. While digging through 60-year-old reports can be a thrilling experience, it requires considerable time and physical access to documents. In practice, old reports and meeting papers are rarely accessed and are not easily searchable.

Recent documents have been made available electronically on SPC's website, but they are scattered in different places and not searchable through a common interface. Moreover, not all fisheries officers in the Pacific have access to the Internet; and those that do sometimes have difficulty downloading documents because of limited bandwidth.

The challenge of this project was to resurrect historical documents and make them, as well as more recent papers, available to the largest audience possible — whether they have access to the Internet or not — and provide search and retrieval tools for thousands of documents collated into a digital library.

A strong collaboration between SPC's library, the Fisheries Information Section and the Reef Fisheries Observatory (with funding from the European Union through the Pacific Regional Oceanic and Coastal Fisheries Project) made it possible to create both a DVD (with annual releases) and an online version of the fisheries library that can be accessed from the Internet

http://www.spc.int/mrd/fishlib.php

The first part of this article describes the general process of creating a digital library, while the second part reviews its practical uses.

Building a digital library

Building a digital library is a process that involves scanning and performing optical character recognition (OCR) on historical documents so that they are searchable in full text. This process also attaches additional information (metadata) such as title, author or year of publication to each electronic document to improve searches and provide relevant results. Archived documents must be indexed using full text and metadata so that they can be searched and retrieved.

Figure 1 depicts this process, and shows that entering metadata and proofreading documents are tasks that require considerable staff time, whereas optical character recognition is a computer intensive operation that can be automated and requires little human intervention.

Optical character recognition of scanned documents

Optical character recognition (OCR) is the process of analysing pages of a scanned document and recognising the text, possibly introducing typos and errors that cannot be corrected automatically. We chose not to proofread the recognised text and to save scanned documents as "PDF/Image over text", a file format in which the original page is displayed as an image, while the underlying text is indexed and searchable.

Performances and the possibility of running automated tasks were evaluated for several OCR applications. We finally selected FineReader™, which performs well on most documents.

Performance, however, is poor for older documents where ink

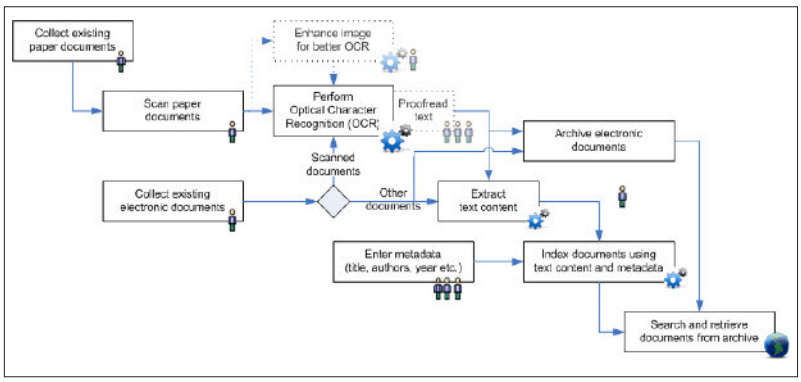


Figure 1: Task flow for building the digital library.

may have faded, bled or diffused through the paper. A typical black and white scan of a text page, for example, uses a threshold to separate text from background, which produces highly contrasted text but wipes out faded characters. The same page scanned as a "greyscale" image can, on the other hand, be enhanced using image processing as shown in Figure 2.

Because grayscale image enhancement takes much more human and computer time than the standard process, it is only used when a document cannot be otherwise scanned or text recognised.

Finally, the quality of text recognition by OCR software is better if the language is correctly set before the recognition is performed. The reason is that the software uses intrinsic properties of each language, such as the probability that a given character follows another, and word lists.

For example, a document in French recognised with English settings will be poorly recognised, which is an issue for SPC's conference papers that are available in both French and English, and for other bilingual documents. Figure 3 shows the impact of language settings on recognition.

Note that it is possible to detect the language of a document a posteriori using recognised text statistical properties, and checking to ensure the language settings were correct, or redoing the recognition with corrected settings.

Bilingual documents are more difficult to process automatically. One solution could be to perform the recognition in both languages and then merge the two documents line by line after language detection; however, this has not yet been routinely implemented in our system.

Metadata, text processing and classification

Attaching metadata to each document can be time consuming, but it is essential both for displaying search results and for determining the relevance of "hits". For example, the presence of search terms in titles or other metadata fields of a document means it is probably more relevant than other documents where the search terms just occur within the text.

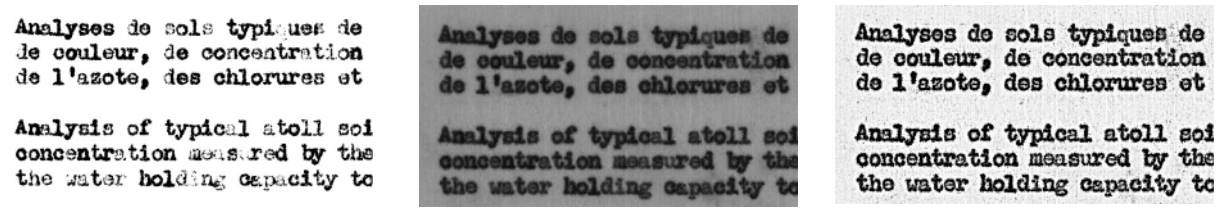
Restricting searches to a certain category of documents is also made possible by metadata. For example, displaying articles from a specific bulletin published during the last three years, or searching documents written by specific authors, is feasible if the information for year of publication, journal and authors has been previously recorded.

Metadata includes:

- Normalised bibliographic elements (MARC, Dublin Core) used to cite the document. These elements can generally be extracted directly from a library catalog such as Koha or bibliographic management programs (e.g. ProCite, Reference Manager, EndNote).

- Keywords and other information about the intrinsic content of the document. Keywords can either be provided by librarians and domain specialists, or they can be inferred automatically by text classification. The pertinence of keywords depends on the broader context of the digital library thematic. For example the keyword fisheriesbrings very little information in the context of the coastal and oceanic fisheries digital library, and could even interfere with a search. In the context of all SPC documents on the other hand, it can be used to restrict the search to fisheries-related documents.

- Information about the context of the document such as:



(1) Moreover, **our** informations **about** phyllosomas and pseudibacus of the genus Scyllarides are summed up, and an **attempt** of a key for **the** identification (…)
Dans un article **precedent**, paru dans les **manes** Cahiers (CROSNIER, 1972), nous avons **etudie** les larves phyllosomes et les post larves de Panulirus

(2) Moreover, **oui**- informations **aboul** phyllosomas and pseudibacus of the genus Scyllarides are summed up, and an **attempt** of a key for **ihe** identification (…)
Dans un article **précédent**, paru dans les **mêmes** Cahiers (CROSNIER, 1972), nous avons **étudié** les larves phyllosomes et les post larves de Panulirus

Figure 2 (top): Document scanned as black and white text, as a grayscale image, and the latter after image enhancement. Figure 3 (left): The same bilingual document recognised with English (1) and French (2) settings.

1. links to other articles and papers from the same bulletin issue or workshop
2. links to other publications from the same author(s) in the digital library
3. list of other publications where the document is cited
4. list of other publications cited by the document
5. list of closest documents in the digital library (measure based on text and metadata)

- Location and properties of electronic files. The same document can be distributed in several formats such as PDF and DjVu or even split into parts to ease Internet download, but all of these files share the same bibliographic and content-related information.

When doing a full text search, metadata is complementary to the text. Because a full text search will look for all occurrences of searched terms in the document and evaluate their importance based on their number of occurrences relative to the length of the document, there is little to gain by adding the very same terms to the keyword list. Yet the relevance of results can be improved by adding synonyms, broader concepts, and disambiguating terms when necessary.

For example, it is possible to search for documents relating to islands or countries that either go by different names or different spellings — Chuuk or Truck, PNG or Papua New Guinea, New Hebrides or Vanuatu — by injecting synonyms during the indexation of documents and the transformation of quoted expressions in queries.

Classification and text analysis can also be used to automatically create additional keywords and give more weight to some terms when evaluating the relevance of results. An additional metadata field with country name for example, makes it possible to restrict a search to documents related to a specific country and improves the relevance of search results that include a country name. This field can be generated automatically based on the geographic names in the title and full text, for example Kiribati will be inserted if the title contains Gilbert Islands or Tarawa.

Finally, disambiguation is the process of analysing the context of the document to determine the meaning of an expression before it is used for classification or replaced by synonyms. For example *T. gigas* can refer to *Tridacna gigas* but also to *Tricornis gigas* or *Tetraedron gigas*. The presence of the term *Tridacna* indicates that *T. gigas* will be expanded to include *Tridacna gigas*.

The creation of synonyms and additional keywords is not mandatory to create a digital library and it complicates the indexing process, however, it greatly improves the results and user experience.

Producing a DVD and online version of the digital library

When metadata and searchable electronic documents have been produced, they must be imported into a system that indexes text and selected metadata and provides an interface to search and retrieve the documents.

For the current DVD version (Digital Library 2006), we used Greenstone 2.71 (available from www.greenstone.org), an open-source software that we customised for use of sub-collections indexes, hierarchical browsing of documents, and to provide an SPC fisheries look and feel. Greenstone is freely redistributable, has a simple search interface, and can be launched from a DVD without any software installation.

For the online version, we developed our own interface using Lucene, a powerful open-source indexer that we extended for multi-word synonyms and preprocessing of unquoted queries to transform list of terms such as American Samoa reef fisheries into quoted terms ("American Samoa" "reef fisheries") and give more emphasis to documents that contain the quoted expressions. The online version currently provides access to more than 5000 documents, compared with 2600 documents for the 2006 Digital Library on DVD.

Because the technologies used for the online and DVD versions are not the same, the results for similar queries can be different, especially the order in which the results are displayed. The on-line search engine is designed to give the best top 10 results as possible for your query whereas the DVD version has more features to browse leisurely the documents.

Using the fisheries digital library

Online digital library

The online digital library can be accessed from:

http://www.spc.int/mrd/fishlib.php

A standard search is done on both full text and metadata, but it is also possible to search only specific metadata fields, and to restrict the search to specific collections (e.g. bulletins, manuals) and languages (e.g. English, French). The help page provides more details about advanced search features.

Figure 4 displays the result of a search on giant clams for the years between 1992 and 2003, where Vanuatu (or a synonym) appears in the title, and where the search is restricted to SPC's *Fisheries Newsletter* and *Beche-de-*

mer bulletins in English. The search result shows the document title and author, its bibliographic reference, as well as the full text fragments where the searched terms appear.

About 50 documents are added every week by the SPC library with an expected completion of the scan of past SPC coastal and oceanic fisheries documents around mid 2008.

Digital library on DVD

The DVD version is made available to Pacific Island fisheries administrations that received several copies of the 2006 version, whereas the online version is accessible by the general public from anywhere in the world.

To launch the digital library, insert the DVD and press Enter Library. This starts the library, launches your favourite Internet browser, and opens the library home page. Once you have entered the library, you can either search the documents by title, authors, countries and text content, or browse the documents by collection (bulletins, meetings, manuals, posters, etc.), title, authors and countries. Finally, you can open the PDF document by clicking on its thumbnail or PDF icon.

Help on queries is provided when clicking on the Help button on the top right of the document.

A new DVD will be released in 2008 with an updated version of the digital library containing around 5000 electronic documents.

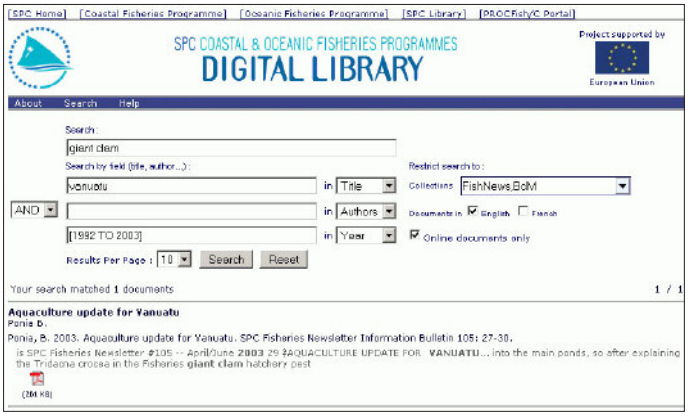


Figure 4: Web interface of the online digital library.

"PARTNERS FOR THE BENEFIT OF ALL"

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The Executive Director of the Conservation Society of Pohnpei (CSP), Patterson K. Shed, did not mince words when he was asked about the work of CSP. The quote below reflects a man obsessed with a desire to achieve nothing but the best for the people of the state.

> *The CSP was established from humble beginnings with an overall vision of people living in a safe and clean environment where cultural pride and natural resources are protected, preserved and balanced with sustainable development. With that in mind, we strive to ensure that this vision is achieved for the people of our state.*

In July this year, I was in Pohnpei to carry out a preliminary assessment for the establishment of a Coastal Fisheries Management Programme for Pohnpei State in the Federated States of Micronesia.(FSM). The assessment was in response to a request from the Pohnpei State Office of Economic Affairs (through FSM's Department of Foreign Affairs) for advice in developing viable programmes and fisheries management plans that promote the sustainable management and use of coastal fisheries resources.

My assignment in Pohnpei was carried out mainly through a simple desk study and literature review, and wider consultations with relevant stakeholders that included meetings with the Marine Resources Development Section (MRDS) staff, NGOs, state government agencies, staff of the Land Grant Programme of the College of Micronesia, the State Attorney General's Office, municipal authorities, and representatives from island communities.

Pohnpei is blessed with beautiful scenery and resources in its coastal areas

Through these consultations, I discovered a unique partnership between the CSP (the premier conservation NGO in FSM) and the MRDS (state government fisheries authority) that I would like to share with *Fisheries Newsletter* readers.

Mandates, vision and responsibilities

Like any other fisheries authority (be it a Ministry, Department, Division or Section), MRDS is mandated to spearhead the conservation and management of Pohnpei's marine resources through the formulation of marine resource and coastal zone plans, policies and management framework; development and implementation of experimental trials for commercially viable ventures; provision of information and technical assistance to fishers and aquaculture farmers; and development of effective extension systems that are capable of providing advice at the municipal government level and development entities in an effort to improve economic opportunities for inshore operators.

CSP on the other hand, was founded in 1998 by a group of local individuals concerned about and motivated by the need to preserve Pohnpei's natural heritage. CSP has an impressive mission to preserve and enhance the natural heritage of Pohnpei State by promoting community-led resource management and compatible economic development.

In simple terms, CSP aims to increase community involvement in the conservation and management of Pohnpei's natural resources, build local capacity through public and private partnerships, develop alternatives to unsustainable practices, and promote laws and policies that support these objectives.

Over the past nine years, CSP has grown to become one of the

region's best known conservation groups, leading the way in Pohnpei's environmental movement through a myriad of partnership projects with local communities, government agencies and organisations.

As a followup to the preliminary assessment, we implemented a workshop for community facilitators in Pohnpei from 24–28 September. There, I once again witnessed that CSP lives up to its mission and vision of fostering working relationships with its partners.

Partners at work

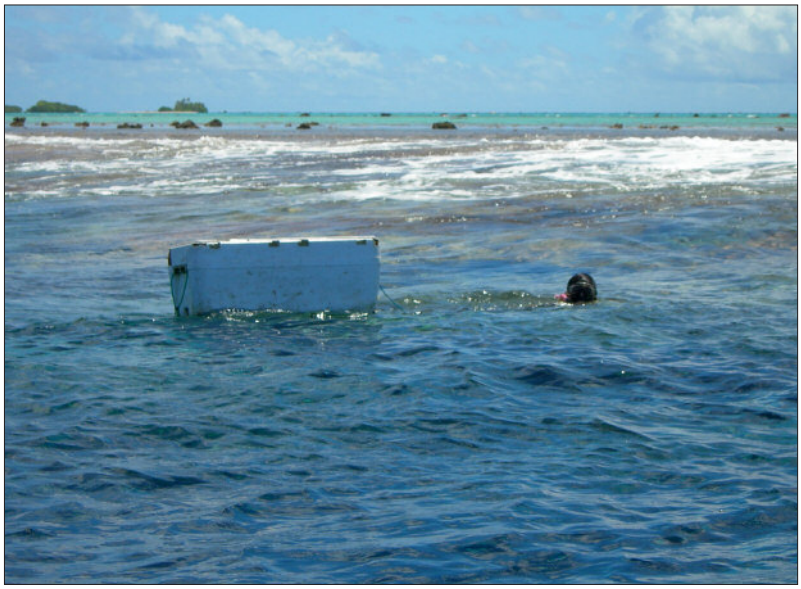
It takes collaboration and dedicated partnerships to effect positive change. CSP is committed to building unique partnerships — one of its cornerstone goals of its local conservation mission. Today, over 30 international organisations and foundations have provided valuable funding and technical support to CSP's work. The NGO has come a long way in building the local partnerships, understanding that one of its major roles is to complement the Pohnpei State Government in the state's quest for effective conservation of its natural treasures and biodiversity. As an NGO, CSP plays a unique and critical link to alternative support options that are not available to government. The NGO pursues those options and today, receives over USD 500,000 in funding assistance.

After nine years of service the organisation has established partnerships with all state resource managers through the established Pohnpei Resource Management Committee (PRMC), which brings together government and NGOs to collaborate and manage state resources more effectively. PRMC works to attain goals of the state Biodiversity and Strategy Action Plan and advocate sound management. As a PRMC partner, CSP has worked closely with Pohnpei State Department of Land and Natural Resources on watershed and valuable wetlands and mangrove issues and conservation, the state Department of Education for the implementation of innovative education awareness programmes such as Green Road Show and Youth to Youth programme to name a few. CSP has also contributed to the establishment of the state's marine protected areas network.

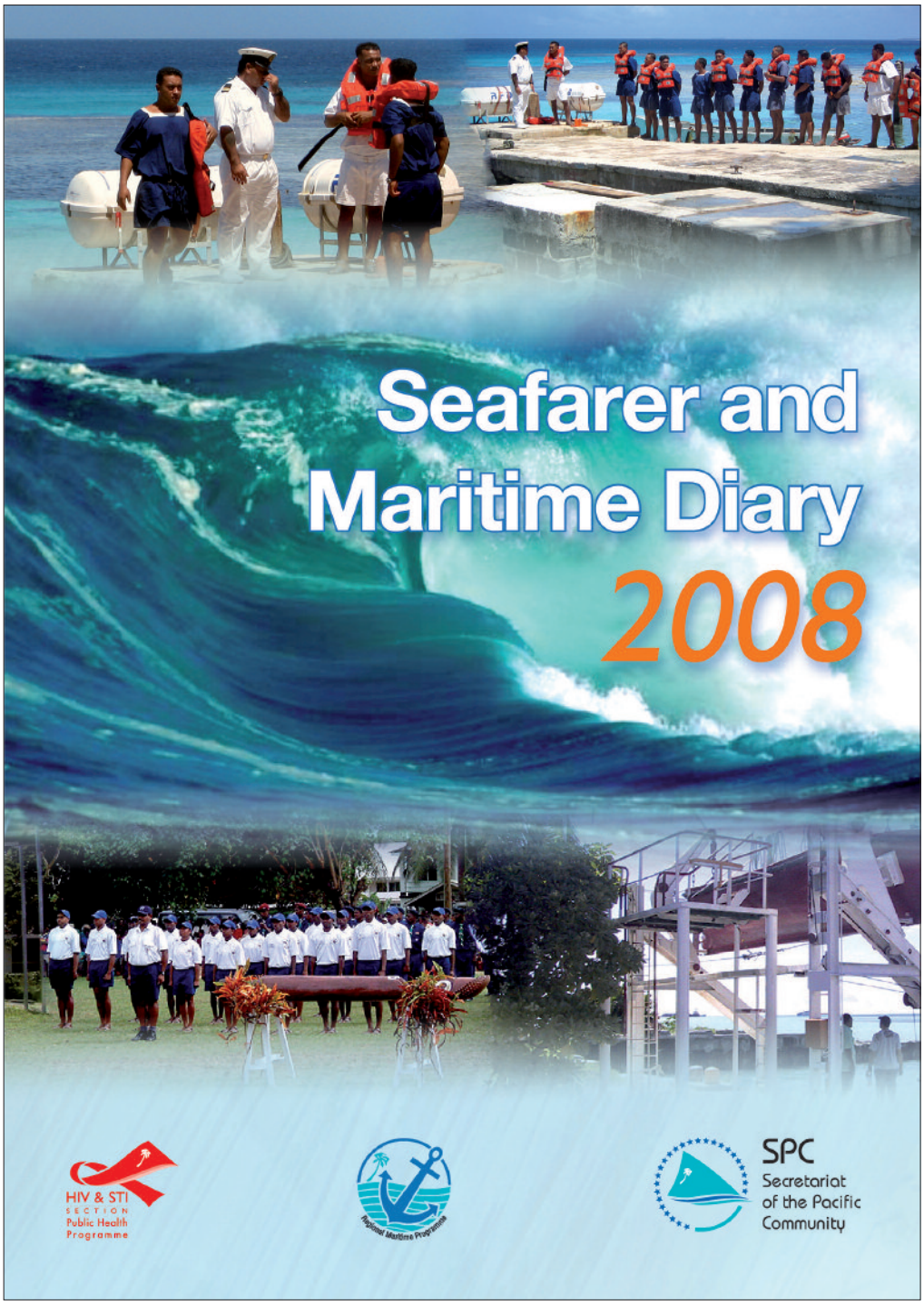
With regards to the conservation and management of coastal fisheries resources, CSP develops its work plan in accordance with MRDS's goals and objectives. MRDS's Chief Fisheries Officer, Donald David, acknowledges this partnership as the reasons behind conservation goals. "MRDS, with its current capacity and financial constraints, is not able by itself to achieve the goals and objectives set by the state. But with CSP's support and partnership, through sharing personnel, expertise and resources, MRDS is able to fulfil its mandate. CSP is like another section of MRDS, and whenever I need assistance, they are always around to lend a helping hand", says David.

Through this unique partnership with CSP, MRDS and the communities of Pohnpei, the state has led FSM in the management and protection of its resources. The accomplishments thus far are encouraging, however there are calls for even closer collaboration and increased efforts to meet Pohnpei's conservation challenges. We owe it to our children to muster the will to work together to provide a brighter future with healthy environment.

This article is dedicated to Patterson Shed, Executive Director of CSP, and his hardworking staff, Chief Fisheries Officer Donald David and staff, the Administrator of the Office of Economic Affairs, and the local communities of Pohnpei State for a fruitful partnership.



A common fishing method in Pohnpei. Spearfishing on the reef and outer reef slopes. The diver drags an esky behind to keep the day's catch.



Pacific Island Seafarer and Maritime Diary now available

A Seafarer and Maritime Diary has been developed for the Pacific Islands region. The diary provides essential information that contributes to the health and well-being of seafarers. The diary is a collaborative initiative between SPC's HIV/STI Section and the Regional Maritime Programme, with funding from the Global Fund to Fight AIDS, Tuberculosis and Malaria and the Asian Development Bank. The diary was developed as part of SPC's work in providing information, education and communication materials to seafarers, with a particular focus on reducing risk and vulnerability of HIV/AIDS and other sexually transmitted infections.

The Seafarer and Maritime Diary 2008 is available from maritime training schools, maritime administrations, crewing agents, shipping companies and direct from SPC. For more information contact spc@spc.int or maritime@spc.int