



Fisheries

Newsletter

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Editorial

Welcome to the latest issue of the Fisheries Newsletter. In March, SPC, with its co-sponsors the FAO, the Commonwealth Secretariat and the Western Pacific Regional Fisheries Management Council, held a regional coastal fishery management meeting in Nadi, Fiji Islands. The purpose of the meeting was to prepare a regional strategy to address common problems associated with coastal fishery resource management in Pacific Island countries, and advise on implementation strategies.

Bob Gillett reported on the results of a study commissioned by FAO on page 14. Some important considerations arise from this study: safety at sea should be an integral part of all fishery management plans; more attention needs to be given to the safety of small fishing boats; marine accident data collection systems need improvement to permit data analysis; and awareness workshops as well as a regional meeting are needed.

Please enjoy the contents!

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in This Issue

SPC activities Page 2

News from in and around
the region Page 14

Exploring the potential for seaweed
farming in Milne Bay Province, Papua
New Guinea
*by Jeff Kinch, Jane Bagita
and Minne Bate* Page 25

Safety aspects of scuba diving in
Pacific Island Fisheries divisions:
Lessons to be learned
by Leslie Farnel and Robert Gillett
Page 32

*The Permanent Secretary for the Public
Commission in Fiji Islands, Ratu Tui Cavuilati,
gave the opening address of the SPC Regional
Policy Meeting on Coastal Fisheries Management,
held in Nadi, Fiji Islands, from 17 to 21 March
2003*



SECRETARIAT OF THE PACIFIC COMMUNITY

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SPC ACTIVITIES

■ FISHERIES DEVELOPMENT SECTION

Assignment in Marshall Islands

SPC Fisheries Development Officer, William Sokimi, began a new project on February aimed at training Marshall Islands Marine Resources Authority (MIMRA) staff and interested local fishermen in the use of tuna longline fishing gear and techniques, using a monofilament system set up on the MIMRA training vessel, *FV Wa-Bal*. Other aims of the project included: assessing the suitability of the MIMRA vessel as a tuna longliner and suggesting parameters for developing a local fishery; conducting deep-water snapper fishing trials (if time permits); and training all participants in correct on-board handling and preservation of catches.

Twenty-three participants were identified for training, including young men from the private sector who were interested in benefiting from commercial off-shore fishing experience (especially tuna longline fishing for sashimi grade tuna), either as crew on fishing vessels or carrying out fishing ventures of their

own. Because this is the first time participants have been exposed to this type of work or training, a two-day tuna handling workshop was conducted at the start.

The tuna handling and processing workshop was held at the Fisheries and Nautical Training Centre. SPC's Fisheries Training and Education Adviser, Michel Blanc, conducted the workshop, using both classroom and practical sessions to explain and demonstrate the correct way to handle tunas for high-priced sashimi markets.

After the fish-handling workshop, participants were divided into two groups to make the training programme manageable. Because of the limited reel capacity, the focus was on training participants in tuna longline operations, so that by the end of the project, a team could be identified to continue with the fishing operations. This would enable the team to gain further experience on their own and continue with training fishermen in training programmes organised by MIMRA.

Participants were shown different tools, fishing gear, fishing gear components and fishing preparations that would be implemented during the project. All gears were then put on the training vessel. Onboard demonstrations were given on gear construction and layout of gear for tuna longline fishing operations. Participants later made up 600

branchlines, rigged floats for attachment to floatlines, rigged floatlines with a snap at one end and a 15 cm eye splice at the other end, and prepared and tested two radio beacons. Participants carried out the detailed requirements for the fishing trip according to a prepared checklist.

During March, each group spent one week preparing for a fishing trip, and one week during the trip making four sets of gear. The first group travelled 30 nm south of Majuro to conduct fishing trials. The limiting size of the reel allowed less than 200 hooks to be used per set, with 32 fish (Table 1) making up the catch from the four sets. The second group fished closer to Majuro, 15 nm to the west. During this trip only 19 fish (Table 1) were caught during the four sets. Most of the fish taken during the fishing trials were sold through MIMRA's fish market or given away, although three fish (two bigeye and one yellowfin tuna) were exported through the Marshall Islands Fishing Venture (MIFV). MIFV also purchased the sharks taken during the fishing trials.

The fishing trials will continue on this project in the second quarter of the year with a new, larger mainline reel ordered to increase the fishing capacity of the vessel, and the effectiveness of the training.



Practical session during the tuna handling workshop

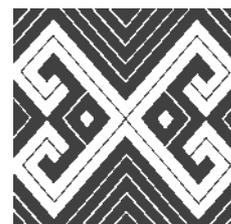


Table 1: Results of the fishing trial conducted in March

Species	Trip 1		Trip 2		Total	
	No.	Kg	No.	Kg	No.	Kg
Retained catch						
bigeeye tuna	1	20	1	38	2	58
yellowfin tuna	2	52			2	52
albacore tuna	1	23			1	23
skipjack tuna	3	11			3	11
wahoo	2	14			2	14
blue marlin	1	28			1	28
mahi mahi	6	18	11	84	17	102
oilfish	2	6			2	6
thresher shark	6	162			6	162
blue shark	3	81			3	81
Total retained catch	27	415	12	122	39	537
Discarded or released catch						
lancetfish	4	8	1	2	5	10
snake mackerel	1	2			1	2
pelagic ray			5	8	5	8
blue shark (released)			1	20	1	20
Total discarded or released catch	5	10	7	30	12	40
Total catch	32	425	19	152	51	577

Regional Policy Meeting on Coastal Fisheries Management

In March, SPC Fisheries Development Officer, Steve Beverly participated in the first Regional Policy Meeting on Coastal Fisheries Management, where he made a presentation outlining SPC's Fisheries Development Section's role in coastal fisheries management — past, present and future. Steve summarised all of the name changes the section has gone through in

the last three decades and how they reflect the change in coastal fisheries development, mainly as a result of the changing requirements and priorities of member countries and territories.

A question that was raised was, "Where do we go from here?" There are no new fisheries to exploit. One answer is to look

again at FAD programmes in the region. The Fisheries Development Section is, in fact, doing just that with the FAD research project in Niue and Cook Islands. As a result of Steve's presentation, one of the recommendations coming out of the meeting was that FAD programmes (and artificial reefs) be included in coastal fisheries management regimes.



Update on the FAD research project

The FAD research project is approaching the end of the second year of this three-year project. Fifteen FADs were deployed from March to April 2002 (eight around Niue, four around Rarotonga, and three around Aitutaki). Of the 15

FADs, two have been lost — one off Niue (after 10 months) and one off Aitutaki (after eight months). The Niue FAD was set in shallow water (400 m) using 150 m of 9.0 mm galvanised wire cable to replace the nylon rope normally used in the upper

mooring. Unfortunately, the bottom splice (at 150 m depth) rusted through, causing the hand-splice to part, even though zinc anodes were used to avoid this. The Aitutaki FAD was set in 960 m of water, with an all propylene rope mooring line,

with a chain counterweight connected to the rope with shackles and swivels, at a depth of around 150 m. The reason why this FAD was lost is not known, although it was reported to be in an area of strong current.

Community surveys

The first community surveys were completed in Niue in November 2001, and the Cook Islands (Rarotonga and Aitutaki) in March 2002.

SPC's Fisheries Development Adviser, Lindsay Chapman travelled to Niue in February to conduct a second community survey. The survey was conducted with the same people, using the same questionnaire used in November 2001. The aim of the community surveys is to try to measure or identify any change in fishing practices over time, especially in regard to fishing around FADs. Of the 155 households surveyed in 2001, 127 were re-interviewed and eight new families were interviewed. Nine families that had been interviewed in 2001 had departed Niue permanently, three families had moved to other villages on Niue, and another 16 families were on holidays. The data collected from this survey

will be analysed in the coming months.

The Cook Islands will have its second survey completed in May 2003. An analysis of the data will then be undertaken. A third set of surveys are scheduled to be conducted in all locations in the first half of 2004.

The third main component of the FAD research project is collecting catch and effort data from local fishermen in each location. Unfortunately, this still remains a major problem area, as fishermen are reluctant to complete log-books developed for this project. At the end of March 2003, only 1000 catch records (log sheets) had been received for the three project locations. This is an area that the project will continue to focus on to try to improve the level of coverage.

A full summary of the work completed up to the end of May 2003 will be compiled and pre-



9.0 mm galvanized wire cable showing splices, one parted

sented to the New Zealand Pacific Initiative for the Environment fund in a progress report. The main findings will also be presented in the next issue of the *SPC Fisheries Newsletter*.



Tuna longline manual

It is expected that the English version of the tuna longline manual will be available in both hard copy and on the SPC website by the end of June 2003.



COASTAL FISHERIES MANAGEMENT SECTION (PREVIOUSLY THE COMMUNITY FISHERIES SECTION)

SPC Regional Policy Meeting on Coastal Fisheries Management Nadi, Fiji Islands, 17-21 March 2003

This regional meeting was organised by SPC and funded by the Commonwealth Secretariat, FAO and WPRMFC. The pur-

pose of the meeting was to provide a forum for country representatives to address common problems in coastal fisheries,

and to suggest ways the SPC Coastal Fisheries Programme and other agencies could assist countries in developing and

implementing management initiatives. The meeting brought together 17 Pacific Island heads of fisheries departments, experts, consultants and interested groups and individuals.

The week-long meeting included discussions and deliberations on issues and topics related to coastal fisheries management in Pacific Island countries. Dr Mike King was contracted to assist with the meeting and with follow-up activities.

The Permanent Secretary for the Public Commission in Fiji Islands, Ratu Tui Cavuilati, gave the opening address. Ratu Tui emphasised the importance of the inshore fishery and the many changes and factors affecting marine resource availability and abundance within the coastal zone. He stressed the importance of research and the management of inshore fisheries, noting the importance of greater support for national attempts at coastal fisheries management. He stated that management was important for maintaining sustainability for current and future use of coastal resources.

Issues discussed

The main topic areas included:

The need for a regional strategy on coastal fishery management

Dr Tim Adams, SPC's Director of the Marine Resources Division, presented a paper that examined the issues involved and the need for a regional strategy. Discussions by participants indicated support for this concept. The need for the development of a regional "toolbox of methods" to be used by countries was highlighted.

Process of identification of problems

The meeting significantly focussed on bringing out concerns, issues and common factors that affect resource use and management in Pacific Island countries. Dr Mike King led discussions with a paper presenting a summary of problems identified through a questionnaire.

Before the meeting, a questionnaire had been distributed to countries. Countries were requested to identify the main problems affecting their fisheries and to propose possible ways of addressing these issues. This exercise highlighted the many similarities in problems faced by countries.

During the meeting these problems were discussed at length, with participants discussing factors and issues affecting resource use and management (see table below).

In addition to the above, respondents noted problems associated with the pollution or degradation of wetlands and coastal zones. Of these, siltation,

eutrophication and uncontrolled or excessive coastal development were prominent.

The capability of national fisheries agencies to manage coastal fisheries

This session generally focussed on the need to include resource owners and users in management initiatives. Mr Semisi Fakahau of the Commonwealth Secretariat emphasized the human resources development (HRD) approach to ensure the effective participation of the owners and users of coastal fishery resources in management. In most instances, countries lack the facilities and financial capacity to implement management programmes on their own. Thus it is important to involve communities and stakeholders. Within this, the need for capacity building was identified.

Discussions from this session highlighted the need for long-term projects to ensure capacity building. Customary and cultural issues were also identified as crucial to the planning process of management and development initiatives.

Main problems identified are listed below in order of importance	
Overexploitation of marine species	78%
Inadequate or outdated fisheries regulations	50%
Inadequate enforcement of fisheries regulations	50%
Lack of capacity in the country (e.g. in stock assessment, data collection)	50%
Destructive fishing methods (e.g. explosives, breaking coral)	39%
Overly efficient fishing methods (e.g. night diving, small mesh nets, scuba)	22%
Overlap between national/provincial/ island responsibilities	17%
Shift from subsistence to commercial fishing	11%
Ciguatera fish poisoning	11%
Illegal fishing by foreign vessels	6%

The collection and use of fisheries statistics

Presentations on this topic were given by: Masanami Izumi, FAO Fishery Officer; Ms Josie Perez, National Statistics Office from the Philippines; David Hamm, National Marine Fisheries Service, Honolulu; Etuati Ropeti of Samoa Fisheries Department; and Dr Tim Adams of SPC.

The session focussed on the importance of statistics in fisheries management and ways of collecting and analysing data. A major challenge is how data already collected (in censuses) can be used for practical management purposes. The importance of involving communities in data collection was also noted as being very important.

In the discussions that followed, many countries emphasised the need for data collection and survey training, and the need for a methodology for both small and large islands.

Dr Tim Adams also discussed how regional organisations could assist with the development of national databases.

National regulations applied to coastal fisheries

Transform Aqorau, Legal Counsel at the Forum Fisheries Agency, spoke on national regulations applied to coastal fisheries. He advised that coastal fisheries legislation is a complex issue in its own right, which justified the development of legal services within SPC. The possibility of

SPC conducting awareness workshops and producing learning materials on regulations was discussed at length.

Dr Mike King spoke about the problems of enforcement, and raised a few questions on the difficulties of enforcement at the national level. The need to simplify regulations for better understanding, the need for regional size limits, and public awareness on application and uses of national regulations were other major concerns that were discussed. There were discussions about the possibility of harmonising legislation and regulations, although the complexities within countries and communities would make this difficult. Another suggested alternative was to decentralise, rather than centralise regulations, and make use of existing traditional institutions.

It was also suggested that maximum size limits as well as minimum size limits should be considered. The need for enforcement and awareness work on legislation was supported by many countries. This was especially in reviewing outdated legislations and also the simplification of currently used legislations.



The week-long meeting included discussions and deliberations on issues and topics related to coastal fisheries management in Pacific Island countries.



The involvement of fishing communities in coastal fisheries management

The meeting emphasised the importance of encouraging and supporting fishing communities to manage their own fisheries resources. This is the basic principle under which the Coastal Fisheries Management Section is operating. The communities and people who own and have access to resources are tasked with the responsibility of managing their own resources. The communities are encouraged to define their own problems with fish stocks and the marine environment, and propose solutions to these problems. The communities are then assisted in setting their own conservation rules, and have the responsibility of enforcing them.

Several country representatives shared their experiences in involving communities in coastal fisheries management.

These included examples of SPC-assisted projects in the Marshall Islands, Samoa and American Samoa. The International Waters Programme, based at SPREP, provided examples from Solomon Islands, Niue and Vanuatu. Cook Islands presented an example of community-based projects initiated by community elders and chiefs with implementation and enforcement relying on the traditional system. The Fiji Locally Managed Marine Areas (FLMMA) network was cited as an example of management with a collaborative approach by NGOs, government bodies and individuals.

Most projects reported on their successes and highlighted the challenges. Some challenges identified included project time frames and how to fit these into community times, problems of transportation, and other locally

based problems that slow down project implementation. The project in some form utilized traditional institutions and regulations to implement and monitor progress of their work.

Discussions following the case studies highlighted a change in how culture is seen as a "hindrance", and how that can be used in fisheries management. There was also concern that publication of work already done on coastal fisheries management in the region should be pursued.

The need for a more appropriate approach to the situation of smaller island nations was raised. This was especially important given the size and overlap in government work and work areas. Samoa also discussed how the management programme is now becoming a political tool.

Gender issues in the management of coastal fisheries

Aliti Vunisea, SPC's Community Fisheries Officer, spoke on gender issues in coastal fisheries management in the Pacific. She stated that this was an issue that had to be considered at all levels of coastal fisheries management. She argued that women are better managers, and the possibility of women taking over management initiatives in the future should be considered. There was general agreement that gender considerations were very important in any management attempt.

Customary marine tenure (CMT) and the empowerment of communities

Mr Ueta Fa'asili of SPC introduced the session on customary marine tenure and the empowerment of communities. Examples

of customary marine tenure were given by Etuati Ropeti (Samoa), Alifereti Bogiva (Fiji Islands) and Tevita Latu (Tonga). The examples presented similarities and differences of the implications of tenureship on resource use, access and management and how CMT could have an impact on planned coastal management projects.

Mr Blaise Kuemlangan spoke on the importance of empowering coastal fishing communities. Discussions suggested that proper legislation could assist in enforcement. Because of issues facing fisheries agencies, there is the question of whether existing legislation is sufficient for addressing new problems.

SPC work related to the management of coastal fisheries

Several presentations were given on SPC's work relating to the management of coastal fisheries. Pierre Labrosse, and Dr Mecki Kronen discussed the work of the PROCFISH project. Steve Beverly (Fisheries Development Section) Ben Ponia (Aquaculture) and Being Yeeting (Life Reef Fish) made presentations as well. There was considerable interest in this session as countries were eager to know the current work of the different sections and how these could contribute to management initiatives.

Organisations, donors and NGOs involved in fisheries management

This session included presentations and discussions by Mr Masanami Izumi of FAO-Pacific, Mr Walter Ikehara of the Western Pacific Regional Fisheries Management Council (WPRFMC), Michelle Lam of the Marine Aquarium Council, Dr Warwick Nash of the WorldFish Center.

Representatives of other major organisations included Ms Sophia Bettencourt of the World Bank, Ms Paula Holland of the International Waters Programme based at SPREP, and Ms Mary Powers of SPREP.

Dr Kenneth McKay of CSPOD and Ed Peek discussed the main development issues to consider when applying for funding. This was to assist countries in familiarising themselves with what to focus on and areas to look at when seeking funding.

Problem-solution tree analysis

A presentation on the use of problem-solution trees in solving problems related to coastal fisheries management was given by Mike King. Groups of participants then practiced using this tool.

Final discussions were wide ranging, resulting in several recommendations. American Samoa believed that community representatives should be given an opportunity to participate at the Heads of Fisheries meeting. The response from SPC was that countries could consider the possibility of including community representation in their delegation.

There was also a recommendation that any future work done by the Coastal Fisheries Management Section should include capacity building. This should involve attachments to SPC and to other countries with management initiatives in place.

In summary, the recommendations were that SPC:

- examine ways to assist countries in collecting inshore fisheries data and developing a statistical data storage system with special empha-

- sis on national fisheries agencies with small numbers of personnel.

- identify resources to conduct training on statistics and data collection, provide advice on the use of these data for fisheries management.

- conduct socioeconomic surveys in countries that have MPAs, to determine if there are difference between areas with MPAs and areas without MPAs.

- establish a legal service to respond to requests from island countries for assistance in legislation related to coastal fisheries.

- document and recommend regional size limits for important species to help countries in the preparation of regulations.

- develop non-technical publicity material to be used in assisting countries in raising public awareness on the need for fisheries management and fisheries regulations.

- assist in the development of national community programmes for the management of coastal fisheries resources

Other discussions by participants centred on the prioritization of SPC activities and resulted in the following recommendations, that:

The SPC Coastal Fisheries Management Section should not be prioritised as countries have different levels of activities that may not accurately be reflected if prioritised.

The SPC Coastal Fisheries Management Section coordinate its activities with the aquaculture, FAD and artificial reef programmes, to promote these as alternatives to existing coastal fisheries.

SPC establish a framework for the implementation of the enforcement of coastal fisheries regulations.

The SPC Coastal Fisheries Management Section should assist with capacity building through attachments of island nationals.

Further work by the SPC Coastal Fisheries Management Section

There is an agreement that there should be a mission to different countries to further work on problems and issues identified. Ueta Fa'asili, SPC's Coastal Fisheries Adviser, Dr Mike King (project consultant), and Semisi Fakahau of the Commonwealth Secretariat started on the mission to countries to assess needs for national coastal fisheries management and will be visiting 14 different countries in six weeks.



■ AQUACULTURE SECTION

SPC provides aquaculture grants to Pacific Islands in 2002

In 2002, the Aquaculture Section spent approximately AUD 10,000 on national projects. The major recipients of these funds were Fiji Islands, Vanuatu, Papua New Guinea and Solomon Islands. A summary of these projects are provided below.

Fiji Islands—Tilapia fish ponds

This project supported a jointly funded programme with the Fiji Fisheries Department and the University of the South Pacific to establish GIFT tilapia fish ponds and to provide training in fry rearing and farming techniques at Driti village. The project will improve food security in the village, provide a source of cash for women farmers, provide a local supply of fry to surrounding villages, and enhance aquaculture skills among Driti residents.

Vanuatu—Hatchery materials for Fisheries Department

Over the past few years the condition of the fisheries hatchery in Port Vila has deteriorated. The hatchery is critical for the mass production of trochus and giant clams, which are used for restocking and fisheries purposes. Funding of hatchery equip-



Top: Sampling Macrobrachium shrimp at Viticorp Farm, Fiji Islands.

Middle: Macrobrachium rosenbergii freshly harvested from Naduruloulou Aquaculture Station, Fiji Islands

Bottom: Tilapia fish that were harvested along with the Macrobrachium shrimp at Viticorp Farm.



Aquaculture hatchery at Vanuatu Fisheries Department, Port Vila.

ment and materials was provided to restore this national centre to operational capacity.

Papua New Guinea—Water quality monitoring equipment for National Fisheries Authority

In PNG, aquaculture is growing in popularity, particularly pond

culture of fish. The National Fisheries Authority (NFA) identified a water quality monitoring instrument for staff to use in assisting farmers in site selection and to undertake research programmes. The devaluation of the PNG kina has impacted on importing such necessary equipment, thus SPC and NFA

shared the costs for purchasing this equipment from Canada.

Solomon Islands—Equipment for seaweed farming extension officers

Following the Solomon Islands' first national training and awareness workshop, the need to support the efforts of the extension officer upon their return to the provinces was realised. The Fisheries Department requested SPC to assist in purchasing basic field equipment such as thermometers, salinity refractometers, masks and flippers.

Small grants are funded through extra budgetary monies provided by AusAID. This scheme will continue to be available to SPC member countries in 2003. For further information regarding how to access this fund please contact SPC's Aquaculture Adviser, Ben Ponia (BenP@spc.int).



USP and SPC to review Aquaculture Legislation and Policies in the Pacific

Knowledge of aquaculture legislation and policies in the region is "patchy" at best. However this may soon change after the University of the South Pacific (USP) completes an SPC-funded project to review the state of aquaculture legislation and policy.

Dr Nathan Evans, USP lecturer in ocean law and policy, will conduct the review and two USP post-graduate students will assist him. The project, which began in March 2003, is expected to conclude with a presentation of results to the SPC Heads of Fisheries meeting in August 2003.

A firm understanding of the status of policies and legislation is important. This information will provide guidance for fisheries agencies in their planning efforts, and will stimulate further detailed in-country or case-specific studies. Derived benefits include positively raising the profile of aquaculture, and reminding agencies of the need to create a transparent and secure regulatory environment in order to attract investment to the sector.

Even exposing gaps in the regulatory framework is an important first step as this will enable SPC to consider the next steps to address the deficiencies.

The project aims to produce the following outputs:

- a review of the status of aquaculture legislation and policy;
- an assessment of legislation and policy gaps at a country and regional level;
- proposed activities in a phase two project to address these deficiencies;
- an appended compendium of relevant legislation.

The work will have strong links to an FAO-proposed fisheries and aquaculture legislation project.



SPC becomes the first organisation granted associate membership to the Network of Aquaculture Centres for Asia-Pacific (NACA)

SPC has become the first organisation to be granted associate membership status in the Network of Aquaculture Centres for Asia-Pacific (NACA). This application was unanimously approved during the recent Governing Council meeting held in Myanmar (formerly known as Burma).

The FAO Technical Conference on Aquaculture in Kyoto, Japan 1976, one of the landmark events in the recent history of aquaculture, established regional networks of lead centres and national centres to carry out applied research, training and information dissemination. NACA was the first network successfully established with national centres in China, India, Thailand and Philippines. Undoubtedly, NACA's efforts have been an important contributor to the success of Asian aquaculture, which today is responsible for more than 90 per cent of the world's production.

While NACA has not had much direct involvement in the Pacific, a number of islands have benefited from the organisation's activities, such as training workshops. The organisation's work programmes have relevant application in the Pacific region, particularly the Asia-Pacific Marine Finfish Aquaculture Network (formerly the grouper network), the Aquatic Animal Health programme and the Aquaculture Education Consortium. For further information regarding NACA, visit their website (<http://www.enaca.org>).

NACA is an ideal collaborative network for SPC's regional aquaculture programme. It provides the Pacific region with a "doorway" into Asia. The recommendation for SPC to seek some form of NACA membership was made by an SPC-funded consultancy carried out by Mr Maciu Lagibalavu, the then Director of Fiji Fisheries.

The granting of SPC's new associate membership status required amendments to the NACA charter agreement and is a new precedent for the organisation. While full membership incurs a yearly fee, the Governing Council agreed to waive any fee for SPC's associate membership under a clause that provides for a review of relations after five years. This is a cost-effective method for the Pacific region to be affiliated with NACA, as small island states may not afford a full, fee paying membership.

Current members of NACA include Australia, Cambodia, China, Hong Kong, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand and Vietnam. Several other Asian countries have membership status pending.



■ TRAINING SECTION

Assessment of a project to network Pacific Island marine trades training schools by using Internet-based resources

The 2003 APIMTIMA meeting was a great venue for conducting this survey and assessing the potential of a regional project for the electronic networking of schools. The purpose of this brief survey was to obtain: 1) information on training institutions' Internet readiness (connectivity, email and internet access, internet/computing skills); 2) information on what the schools would like to have on an institution website and what they use Internet for. This information/comments collected will provide baseline information for evaluating the need or

limited use of electronic networking of maritime and fishing schools.

The "Project to network Pacific Island marine trades training schools by using Internet-based resources" consists of allowing those interested in marine trades to communicate, using telecommunications services on Internet.

The objectives of the project are to:

promote training in member countries;

provide instructors with more teaching tools; and

stimulate the exchange of ideas between various Pacific Islands and outside marine trades training agencies.

The project will make full use of Internet resources to help schools go online. The schools will be accessible through Internet search engines and will allow Internet surfers to find the training course that suits them. The pages will appear in English, and will also be aimed at training instructors. The pro-

ject plans to set up discussion forums for all involved to participate in. For instance, training instructors preparing a class will be able to put their technical queries to the forum and receive, in return, the latest information or even audiovisual aids.

The Training Section can provide technical assistance and advice in the following areas:

- creating homepages to present to the various agencies;

- creating newsgroups to exchange ideas and advice about problems encountered in teaching maritime trades;

- putting on Internet the information and documents about training, maritime fisheries and navigation.

The Training Section is in a position to coordinate the project. In each participating country, a partner will act as administrator for one part of a common server.

Long-distance contacts, meetings, postal correspondence and use of the server will make it possible to coordinate the project; create, assess and improve the system; and make other potential users aware of it.



Bycatch training/awareness-raising initiative

In early April 2003, Training Section staff attended the annual regional meeting organised by SPC's Regional Maritime Programme. Michel Blanc, SPC Fisheries Training Adviser, gave an informative presentation on bycatch awareness training for tuna longlining in the Pacific. Michel gave an overview of pelagic tuna longline fishing. He explained that mainlines of up to 150 kilometres in length and up to 2000 to 3000 baited hooks with buoys to hold up the mainline are used, noting that the line is usually hauled the same day it is set.

One important aspect of longline fishing is the depth the line is set. The depth of the set depends on the number of hooks between floats — the more hooks, the deeper the set — and the speed at which the line is set (the more line in relation to vessel's speed, the deeper the set). Some shallow sets target swordfish, and deeper sets tend to target tuna.

Pelagic longlining in the Pacific is very important, with somewhere between 1500 and 2000 active longline vessels fishing. The number of domestic longliners operating in the region, however, has been increasing

with about 500 vessels operating in the region, with a commensurate decline in DWFN fishing vessels. About 15,000 tons of fresh fish were exported in 2001. The number of jobs on board fishing vessels is nearly 3000, and there are about 5500 shore jobs, including those in tuna canneries.

Pelagic longlining is an environmentally friendly fishing technique, because it does not touch the seabed, and when the longline is lost, once the bait on the hook is gone, the fishing is stopped. Only mature fish are caught and only two tuna are caught for every 100 hooks, so it is a very selective fishing method. So what is bycatch? Bycatch are those species in addition to those you targeted (e.g. yellowfin, albacore, and big-eye) as well as those byproducts that are caught, including marlin, mahi mahi and walu; other species are occasionally caught and which have no commercial value (pelagic rays), or are protected (turtles) or sharks (sometimes fished for their fins, but the body is discarded overboard). These fish that are caught but discarded are called bycatch.

Many species of turtles are in decline, which may be caused

by coastal development, hunting, marine pollution, or as a result of tuna long lining. The other problem is the perceived overfishing of sharks, although not as great a problem in the Pacific as in some other areas, although there has been a decline in reef sharks. A third problem is the interaction between tuna longline gear and seabirds, especially in the higher latitudes and especially with albatrosses. If the problem of seabird bycatch is not addressed, it could result in the closing of the fishery in the Pacific. Therefore, fishermen should follow the guidelines for the proper release of bycatch, and fishermen should keep proper records to be handed over to the appropriate government departments. Also, setting the longline deep and not using squid for bait will avoid catching turtles.

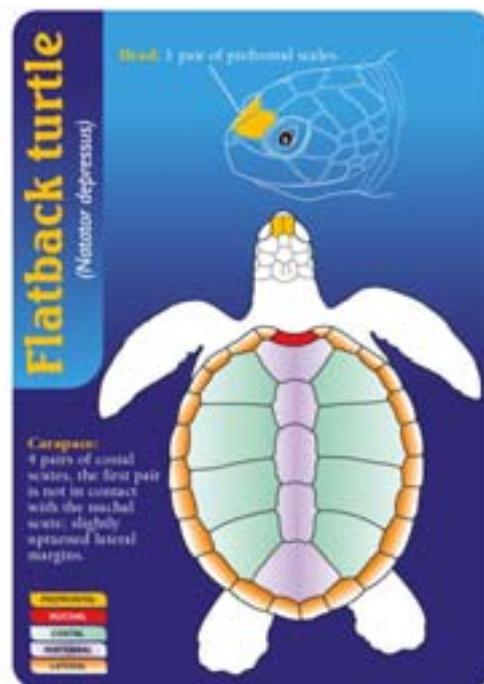
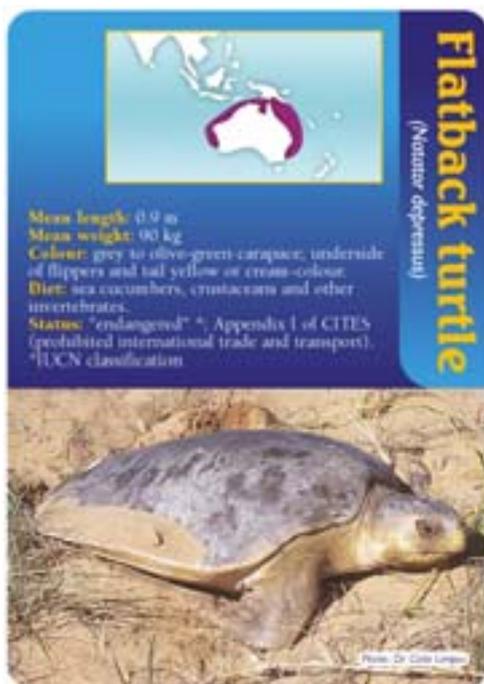
SPC is trying to be proactive (not wanting to wait for the problem to come to our region), by informing governments and raising fishermen's awareness by advising training providers. A small brochure has been developed, which is available to governments and fishing companies, and which will be distributed to delegates of the

bycatch meeting. Furthermore, guidelines for releasing hooked turtles alive have been produced on A-4-sized laminated cards for use aboard fishing vessels. A set of pocket-sized laminated cards for identifying turtles is also under production.

In Hawaii, fishermen must attend a protected species workshop before they can renew their fishing licences. It has been suggested that a similar training

workshop be part of the ongoing fisheries training within the region. It may add a half-day to the current training module. Many delegates agreed that it would be useful to have the material distributed to maritime training institutions within the region. The bycatch meeting resolved that the SPC Fisheries Training Section should develop the awareness material. A formal resolution was drafted, stating,

Recognising the importance of tuna longlining to the economies of PICTs and following the development of bycatch awareness materials by SPC, the meeting resolves that the SPC Fisheries Training Section makes available to maritime training institutions throughout the region, a training module on bycatch issues in tuna longlining.



■ PACIFIC ISLANDS SEA SAFETY SURVEY

Sea safety and related issues are crucially important in Pacific Island fisheries. In some countries the accident rate for fishers is among the highest in the world. Over the last four decades various UN agencies, regional organisations, donor agencies and others have made efforts to address the situation. On a regional level, FAO implemented in 1991 one of the largest sea safety initiatives in the region — a survey of sea safety issues in 16 countries. This was followed by efforts of the Secretariat of the Pacific Community (SPC), especially in the area of sea safety awareness.

In early 2003, FAO undertook another survey of fisheries-related sea safety in the region. The objective was to consolidate the experience gained by selected Pacific Island countries in safety at sea, with the view of improving ongoing and future activities in the region. This report summarises the survey's findings. Five major themes were covered in the survey: the relation of fisheries management to sea safety, safety programmes, data recording, legislation, and boat building and vessel design.

Ideally, a sea safety study in the Pacific Islands would entail visits to each country. Unfortunately, funding and time constraints dictated that, unlike the 1991 FAO survey, only five countries would be directly surveyed in the present study: Tuvalu, Tonga, Samoa, Fiji Islands, and Kiribati. It was the intention that by surveying a selection of five countries from Melanesia, Polynesia, and Micronesia, including both atoll and high island countries, many of the important sea safety issues and recent developments in the region would be covered.

Survey Findings

1) The Relation of Fisheries Management to Sea Safety

The concept of including sea safety as a specific objective of fisheries management is not common in the surveyed countries. In several countries, safety appears to be considered when formulating management interventions, but the idea that saving lives of fishers could be one of the stated objectives of government management intervention does not occur in any of the five countries.

There are several reasons for this. In some countries there is the view that the primary objectives of fisheries management are limited to biological and economic issues. This belief is shown in the tuna management plan of one country, which states that the plan "discusses options for the management of the tuna fishery and makes recommendations intended to enhance its sustainability and profitability. Infrastructure, safety issues, catch handling, and training for the industry are addressed in separate documents."

An associated issue is the imprecise "fuzziness" of the term "fisheries management". Many fishery officials in the Pacific Islands region tend to equate fisheries management with "administration of fisheries". The concept that fisheries management is to be oriented towards attaining specific objectives is not always practiced. In this situation, the potentially beneficial relationship between fisheries management and safety can easily be overlooked.

Another reason why the link between fisheries management and sea safety is not strong is the nature of the fisheries legislation in some countries. The fisheries laws of several countries are restricted to (as stated in one country's law) "regulating matters relating to the conservation, protection and maintenance of a stock of fish". Put more crudely, the fisheries laws of some countries are more about the safety of fish than the safety of fishers.

An important point is that during the course of the present study, there appeared to be little objection on the part of government fisheries officials to including safety in fisheries management. On the contrary, several fisheries managers were enthusiastic about the idea when discussed.

To ensure that sea safety is included in fisheries management, a number of measures should be considered:

Raising awareness of government fisheries officials that safety is a legitimate and desirable objective of fisheries management interventions;

Sensitising those individuals responsible for the legislation (and those providing regional advice on fisheries legislation) to the concept that the scope of the fisheries laws/regulations should allow coverage of safety issues;

Because it is the tuna fisheries that are linked strongest to sea safety in most Pacific Island countries, it is in the area of tuna fisheries management where attention should be focused.

2) Safety Programmes

The common types of initiatives in fisheries-oriented sea safety in the Pacific Islands in the past decade have been:

The SPC regional safety awareness programme;

Radio awareness programmes by various government agencies;

Provision of subsidized safety gear, usually sponsored by donors;

Revision of national shipping legislation to include fishing vessels;

Institutional safety courses as required by revised legislation;

Campaigns of enforcement of sea safety legislation;

Vessel communication upgrades.

These various programmes have ranged from discrete donor projects to regulatory functions of government agencies. The actual measures being promoted by the programmes can be very different; they are largely oriented towards the prevention of accidents, but also include self-help when in distress, and search/rescue efficiency.

Some observations on the major programmes are:

Many of the government fisheries agencies are not especially active in sea safety work. In several countries, the main safety activity of the fisheries agency is distributing SPC safety materials.

The FAO 1991 study stressed the value of safety awareness programmes. This assertion has had a major influence on

the type of sea safety programmes during the past decade.

Most of the major national programmes in sea safety were catalysed by disasters or multiple disasters.

The targets for the sea safety programmes range from urban based-semi-industrial vessels to skiffs based in remote locations. Appropriate safety-improvement initiatives can be very different for the various categories. This applies to the value of safety legislation for improving safety, the type of awareness campaign needed, and striking the correct balance between legislation and awareness. Some shipping-oriented sea safety programmes in the past have often not been very sensitive to smaller boats.

Despite the difficulty in assessing effectiveness, some observations and comments can be made. In general, survey findings in the five countries suggest that the following are generally successful:

Appropriate small-vessel legislation backed up by "big stick" enforcement for urban-based commercial vessels;

Radio programmes and extension visits for remote locations;

Video for those communities with access to video facilities;

"No survey, no license" for areas/fleet strictly controlled by licensing;

Institutional safety courses for the semi-industrial fleet.

In general, there is some sentiment on the part of officials and industry participants in Samoa, Fiji Islands, and Kiribati that

small-scale fishers are either more conscious of sea safety issues and/or are carrying more safety gear than in the past. Individuals in those countries tended to believe that continual awareness programmes are responsible, or at least contribute to the success. Any improvement in Tonga and Tuvalu was less evident in the present study.

The results of some initiatives appear disappointing:

The promotion of emergency sail rigs and auxiliary sail rigs in areas where there is no continuing tradition of sail use has not been successful;

Providing subsidies for safety gear without a long-term subsidy strategy;

The sale of safety gear through government fishery agencies.

3) Data Recording

Recording data on sea safety incidents was a topic investigated in each of the five countries visited during the survey. An examination of the various procedures allows the following observations:

Most government fisheries agencies do not have major involvement in recording data on accidents. It is the maritime administrations and/or the police that initially receive the accident reports and record/store information.

In most countries, the initial reports are actioned, and subsequently filed. Detailed accident data is therefore likely to be available in each country from files. There is often the contention that summaries are given in the annual reports of the agen-

cies, which is often not the case.

In most countries visited, not much importance was attached to producing annual sea accident summaries with sufficient detail so as to be useful for sea safety programme planning.

In countries where sea accident summaries are available, they are frequently not exclusive to fishing craft. Incidents involving passenger vessels and yachts are common and on several national accident summaries it is not obvious which incidents relate to fishing operations.

Many of the available summaries do not represent all sea safety incidents, but rather lists of operations that the recording agency is involved in.

It was not evident during the surveys of the five countries that any follow-up action was carried out, such as debriefing the victims, obtaining detailed information on causes of the incident, or correction of the data for victims who turned up months later.

As a result of these difficulties, in most of the surveyed countries, the readily available data on sea accidents falls short of its potential in promoting sea safety. That is, focussing future safety programmes, generating political will for measures to prevent accidents (e.g. awareness of lives lost or money spent on search and rescue, and judging the effectiveness of past sea safety programmes).

The value of data for focussing safety projects seems to be underestimated in many countries. In Samoa, where there is a relatively good system in place,

the summary information on incidents of sea safety permits identification of accident-prone situations with respect to vessels, areas and seasons.

4) Legislation

One of the major outstanding issues in national sea safety legislation is the coverage of small fishing boats. These are the vessels that are associated with most sea accidents in the region, but they are excluded from both the fisheries and shipping legislation in most countries as shown in the table below.

In the survey of the five countries, only one country was found to have appropriate safety legislation for small craft, while other countries either excluded small fishing vessels or had inappropriate rules. Applying the lessons of the past, any formulation of mandatory sea safety requirements for small fishing vessels should:

Be done with substantial technical input from individuals with thorough knowledge of these vessels and the fisheries in which they participate;

Be sensitive to the practicalities of enforcement in remote locations;

Be conscious that many problems of sea safety cannot be addressed through legislation;

Aim to achieve an appropriate balance between legislation and awareness for improving sea safety;

Be sensitive to the difficulties in political acceptance of new controls on small-scale fishing activity;

Be aware of the difficulties concerning applicability of generic regional legislation.

Enforcement of legislation is a critically important issue in sea safety. The results of this survey suggest that for a country to be serious about improving its sea safety situation, that country must be serious about enforcing its legislation. This concept, however, must be balanced with the reality that there are major enforcement problems. Two countries in the survey have few enforcement problems, simply because there are virtually no

Country	Safety Aspects of Fisheries Legislation	Safety Aspects of Shipping Legislation
Tuvalu	Does not cover vessels under 7 m	Does not cover fishing vessels
Tonga	Does not cover fishing vessels under 6 m (*); requirements for fishing vessels over 6 m usually enforced for only company vessels	Does not cover fishing vessels under 8 m
Samoa	Covers all commercial vessels; requires safety certificate under shipping legislation	The Shipping (Small Vessels) Regulations 1999 cover all vessels that are less than 15 m in length
Fiji Islands	Does not cover sea safety	Fiji Small Craft Code covers all commercial vessels under 10 m, but is inappropriate for small fishing vessels
Kiribati	Does not apply to vessels under 7 m	Does not apply to fishing vessels

(*) New legislation is pending

safety regulations applicable to the vast majority of their fishing fleet. The enforcement problems in the other three countries of the survey show great inter-country differences. The one common problem appears to be the difficulty of enforcement in remote areas. This problem is likely to be even greater in some of the Pacific Island countries not covered by the present survey.

Enforcement of sea safety regulations in remote locations may be an intractable problem. It could easily be that improvement of safety at sea in those areas could best be addressed by other means, especially awareness programmes. Further work on this subject may benefit from expertise outside the fisheries and shipping sectors, such as individuals experienced in social aspects of community development in the Pacific Islands region.

5) Boat Building and Vessel Design

The link between boatbuilding, vessel design, and sea safety is closely tied to FAO's past work in the Pacific Islands. In the 1980s, much of FAO's attention to the region's fisheries sector was focused on naval architecture and support to boatbuilding. A 1990 FAO publication stated that FAO had produced plans for 30 different vessels, including those designed specifically for Cook Islands, Fiji Islands, Kiribati, Niue, PNG, Samoa, Solomon Islands, Tonga, and Vanuatu. FAO has established, assisted, or enhanced boatyards in all those countries plus Tuvalu.

Presently there is very little FAO activity in the Pacific Islands dealing with designing/building boats. An important issue is whether this field with respect to FAO is: a) a neglected area, b) a situation in

which local capacity has been built up to the point that FAO interventions are not required, or c) conditions have evolved so that it is more efficient to import boats produced where production costs are cheaper.

There is certainly room for speculation and there are obviously great differences between countries. The survey results in several countries suggest that many Pacific Island countries are in a similar situation to that of Tonga:

"The reality is that boatbuilding is expensive in the country and in the age of globalization, the market forces and preferences of small-scale fishers favour the use of mass produced skiffs from overseas. With respect to larger vessels, the fishing companies much prefer to import new or used vessels from overseas where construction is more efficient. Given this boatbuilding situation, the major issue in Tonga in the interface between naval architecture and sea safety appears to be measures to assure that the imported vessels are safe. This may range from establishing import standards for mass-produced skiffs to identification of features important for the safety inspections of longliners from Asia."

In a smaller number of countries, probably limited to Kiribati and Tuvalu, the situation with respect to safety/boatbuilding is quite different. There are a number of small boatyards building mainly wooden fishing vessels. It has been pointed out that improvements in construction techniques used by the mainly indigenous builders could lead to safer vessels and a reduction of accidents at sea.

An important point is that it is unlikely that limited donor interventions in the field of vessel design will reverse trends

that are fuelled by market forces, preferences, government policies outside the fisheries sector (e.g. lowering of import duties, reduced government participation in commercial activities), and changing lifestyles. Rather than attempting to alter the evolution of vessel design in the region to improve safety, it may be more productive to "go with the flow" and promote safety features and construction standards for the types of vessels that are now common and are likely to grow more common in the future.

This concept is especially applicable to fibreglass skiffs. Although statistics are lacking, it is probable that most of the new small-scale fishing vessels in the Pacific Islands are either imported or domestically manufactured fibreglass skiffs.

Quite simply, the safety aspects of fibreglass skiffs cannot be ignored. Depending on the country concerned, improved standards of construction and mandatory safety features of fibreglass skiffs would focus on either domestic construction (e.g. Fiji Islands, PNG, Solomon Islands) or import requirements (e.g. USA-affiliated Micronesian countries). Alternatively, there is the possibility of working directly with major overseas manufacturers. In any case, it appears that attempts to enhance the safety of these craft could benefit considerably from appropriate global experience in making safety improvements to fibreglass skiffs.

Conclusions

Sensitising fishery managers to the concept that sea safety is a legitimate and important objective of fisheries management. Progress in this area could have a very positive impact on sea safety in the region. There appears to be no

Summary of the National Sea Safety Issues and Lessons Learned

Country	Issues in Improving Sea Safety	Sea Safety Lessons Learned
Tuvalu	<ul style="list-style-type: none"> Upgrading the recording and analysis of sea accident data; publicising sea accident data. Modifications to the Fisheries Act and Shipping Act to allow for coverage of the type of vessels commonly involved in sea safety incidents. Formulation of a strategy which would result in offshore fishers carrying safety gear. 	<ul style="list-style-type: none"> Having offshore safety gear available is no guarantee that it will be used. Radio programmes on sea safety in the vernacular appear to have a major impact. Lack of recording, analysis, and publicity of sea accidents and government costs associated with these accidents, can lead to weak political will for sea safety improvements. Convincing fishers to change their habits may take considerable effort, as judged by a man who went on two long drifts before being convinced of the need for safety gear.
Tonga	<ul style="list-style-type: none"> The frequency and severity of sea safety problems is not widely appreciated in Tonga. Lack of enforcement of fisheries legislation for the smaller vessels. Most fisheries officers, other government officials, and representatives of fishing companies support mandatory safety requirements, but there is considerable apathy on the part of small vessel operators. 	<ul style="list-style-type: none"> The requirements for improving the safety of small fishing vessels are very different from those needed for the larger company-owned vessels. The best safety legislation is of limited value if not enforced. For a major improvement in safety on small boats, more is required than just awareness programmes. Compulsory measures are needed but there does not appear to be the political will necessary to enforce such requirements. Without a good knowledge of the magnitude of sea safety problems in terms of number of incidents, lives lost, and cost of search and rescue to Tonga, it is easy to understand the lack of enthusiasm and political will for new sea safety initiatives.
Samoa	<ul style="list-style-type: none"> There is a large difference in safety issues between vessels based in the Apia urban area and those in remote locations. The sea safety concerns of owners are very different from those of skippers/crew. Balancing the need for safety training of vessel crew with the reality of large crew turnover. 	<ul style="list-style-type: none"> Mandatory requirements accompanied by a "big stick" approach to enforcement has worked best. The analysis of past data on sea safety incidents can be very useful for future safety programmes. There is a very big difference in attitudes between vessel owners and those who go to sea, with regards to sea safety. To be effective, the penalties for non-compliance must cause substantial pain to the offending owners. There is a need to educate skippers and crew to refuse departure for sea on an ill-equipped vessel.
Fiji	<ul style="list-style-type: none"> Enforcement at sea of safety regulations. Realistic sea safety regulations for small fishing boats. Getting the awareness message to isolated villages. 	<ul style="list-style-type: none"> A major sea disaster may be required to generate political will to improve sea safety. Radio appears to offer the greatest opportunity for sensitising remote village to sea safety issues, and is certainly better than dependence on non-existent distribution channels of some government agencies involved in sea safety. As the use of fibreglass skiffs is likely to grow in Fiji and the region, more attention should be focussed on appropriate construction standards.
Kiribati	<ul style="list-style-type: none"> Coverage of fishing vessels under 7 m by sea safety legislation, including provision for safety equipment, design criteria, and vessel inspection. Subsequent enforcement of any such legislation. The need for an ongoing safety awareness programme on every island. 	<ul style="list-style-type: none"> Most people who go missing are inexperienced with vessels operation at sea. Full-time commercial fishers in Tarawa are becoming more aware of safety at sea. Emergency sail rigs will often be left at home if they have no other purpose than safety. If the sail can be used for sun and rain cover it will usually be carried, if the rudder and leeboard are a section of floor, they will usually be carried. Oars or spars must be useful in the fishing operation if they are to be carried. A small auxiliary engine will generally end up on another boat. A second engine is expensive, but because dirty fuel and running out of fuel are common, it is no guarantee of safety.

major objection to the concept among fisheries managers of the region, but rather they are unfamiliar with the concept and its potential benefits. Because it is the tuna fisheries that have the strongest relationship to sea safety in most Pacific Island countries, it is in the area of tuna fisheries management where most attention should be focused in order to encourage the management-safety link. As most of the national tuna management arrangements in Pacific Islands are specified national tuna management plans, the modification of those plans to specifically address safety would represent an important step.

Focusing more attention on small fishing vessel safety. The reality is that small fishing boats probably cause most of the sea safety problems in the Pacific Islands region but have received the least attention in terms of legislation, construction standards, enforcement strategies, regional discussions, training on proper use, and other schemes to improve safety. Not only do vessels under 8 m deserve more attention, but the attention is needed in a different form than what has been used in the past. In the future,

the various types of safety interventions should be oriented more towards those types of vessels that are popular now, and likely to be so in the future, rather than attempts to alter preferences.

Improving systems for recording/analysing sea accident data and making use of the results.

The effective analysis of accident data can have a remarkably positive effect on two important areas: 1) formulating and targeting of sea safety programmes, and 2) determining the cost of sea accidents in terms of lives lost and government expenditure for the crucially important generation of political will. The major tasks are demonstration of the benefits of data recording/analysing, establishing/refining systems (including the possibility of promoting a standard regional form), and using the results for educating responsible authorities.

Awareness programmes. Education on sea safety through publicity campaigns was the major conclusion of the 1991 FAO regional safety study, the main theme of SPC's safety work, and is thought to be responsible for much of the progress made in sea safety dur-

ing the past decade. In recognition that such safety awareness work should be an ongoing process, current awareness programmes should continue, but with some modification. More effort should be made to get the awareness message to remote places where it may be the only practical mechanism for improving safety. Another important consideration is that the highly-appreciated SPC safety awareness tools should be viewed as a complement to national awareness efforts, not as a replacement.

Regional sea safety workshop.

A meeting that is oriented towards small fishing vessels and which is attended by motivated people from several relevant disciplines, focused on challenging issues, and co-hosted by SPC could produce results having a positive effect on regional and national sea safety programmes. To be effective, follow-up work would be required to disseminate and facilitate implementation of the workshop output.

The full survey report is available by contacting GPA at:

www.gillettpreston.com

(Source: Gillett, Preston and Associates, May 2003)



■ CORAL REEFS AND POVERTY KEY SHEET

Overview of the debate

Over the last five years the debate about coral reefs and poverty has focussed on:

The conservation of reefs with reef-dependent people being considered more as part of the problem and less as possible victims of reef changes.

Linked to this, the debate has included the relative values

of reefs to global biodiversity, tourism, science, coastal protection, fisheries, society as a whole, and, only more recently, to poverty reduction; and how to harmonise these competing uses.

Understanding the level of damage and threat to reef systems globally, the causes of these changes and how to respond through the development of efficient and effective reef management systems.

The future vulnerability of some coastal communities, especially small island developing states, to major and irreversible shifts due to climate change and increasing coastal population pressure.

Conflicting aims of policies related to coral reef conservation, sustainable use, coastal development, and tourism, and the policy instruments to achieve these aims.

Access rights of reef dependent communities to common pool reef resources, their rights in decision-making processes on reef use, and their role and responsibilities in causing and resolving reef related problems.

Complementing conservation strategies with alternative income generating opportunities for reducing pressure on already depleted resources and thus linking into wider coastal development.

Key issues in decision making

The resource: Its threats and trends

Coral reefs are some of the most biologically diverse and productive ecosystems in the world. They are also some of the most fragile. They are slowly built but quickly destroyed and they all too often lie in that area of the sea where pollution, waste and bad practices from other sectors accumulate and do most damage. Almost half a billion people live within 100 kilometres of a coral reef and around 60% of the world's reefs are threatened by human activity with those in Southeast Asia the most threatened (80% under threat).

Reefs occur in over 100 countries and cover some 600,000 km² globally. They have highly diverse structures with many different species, and their shelter and productivity attract and concentrate high levels of biomass from the open sea. The different species interact with each other to provide a supply of resources throughout the year for reef dependent communities. The physical structure of the reef affects local coastal processes, such as sediment movement and wave action and

protects coastal communities from storm damage. Reefs often give rise to islands that provide habitats for people, nesting sites for birds and turtles, and lenses of fresh water for drinking and agriculture. The sheltered areas behind reefs also provide stable environments for the establishment of other productive areas such as seagrasses and mangroves, and provide services for the wider coastal ecosystem.

Major causes of reef degradation include:

Habitat destruction, sedimentation and pollution from local and distant activities, including coastal development, tourism, aquaculture, forestry, agriculture, livestock activities, urban growth, port construction, shipping and shipping channels;

Overexploitation of reef-based resources and destructive practices, such as dynamite and cyanide fishing and coral mining;

Climate conditions and climate change.

Stakeholders dependent on the reef

Coral reefs impact the livelihoods of many millions of people worldwide especially in Asia, the Pacific, East Africa and the Caribbean. In some areas, particularly small island states, that dependence is extremely high. Many of these people are very poor and highly dependent on the reef. Others depend upon the reef as a key-stone resource to ensure that they escape the worst of poverty. These people are extremely vulnerable to reef degradation and many are starting to become poorer. The poor in coastal areas can be thought of as the interstitial poor as they are often difficult to see within the widespread development that often occurs in this area. They fall into the development gaps because they do not have the resources to take up the available development options. The number of dependent people is increasing



<http://www.photo.lib.noaa.gov/reef/images/big/reef0482.jpg>

due to natural growth and inward migration to coastal areas.

Key features of stakeholders associated with reef ecosystems are:

They tend to be small-scale poorer operators because the biological and ecosystem diversity of the reef does not lend itself to mass exploitation of the resources.

Key groups include small-scale fishers, fish processors and traders, subsistence and poor consumers, people who use the reef for building materials.

Some are full-time fishers, others are part-time. Many people depend on the reef at times of stress in their livelihoods; others are engaged in land-based activities and fall back on the reef at certain critical times.

The old and the very young are able to exploit the resource because it is has protected areas on its landward sides, and women can glean the reef without the use of boats.

Class, caste, tribe, ethnic origin and reef tenure systems traditionally influenced access to the reefs in many countries but this is eroding rapidly.

A wide range of coastal people also benefit from the physical protection provided by reefs.

Livelihoods for the poor

Coral reefs are often valued as places of beauty that attract tourists and marine biologists, and provide many forms of fish for developed world aquaria or restaurants. Economic estimates

of this value to wider society have been generated to inform decisions about reef use and interventions. However, the vast majority of reefs in developing countries provide the foundation of the livelihoods of the coastal poor and a key-stone resource or vital safety net for many vulnerable coastal people whose livelihoods are land-based. Benefit flows to these poor and vulnerable people may not score high from an economic perspective but in livelihood outcome terms they are vital.

They provide seasonally stable sources of food, building materials, a medium of exchange, medicines and a source of income and status. It is the reef that protects the coastal villages from storms and wave action and the inner lagoons provide a reserve of food in all weather conditions. This contribution to household food security is particularly important to female heads of households and other very vulnerable groups.

The diversity of products provide opportunities for many with different skills to become engaged and to access different markets, many of which are associated with increasingly important export markets. The structural and species diversity of the reef favours small-scale production and makes large scale exploitation of the reef difficult and so opportunities for small-scale producers are preserved. The common pool nature of many of the resources allows easy entry for those who are displaced from other sectors, especially in times of emergency, but the high degree of skill required to understand the reef fully means that barriers to entry still limit uptake of more complex harvesting strategies.

Unlike many fisheries, where women are excluded from production, reefs offer opportuni-

ties for women to collect by foot, this has significant benefits in empowering women in the household, and different reef-based strategies between men and women spread household risk. The physical structure of the reef dictates that many activities are done communally and the traditional linkages between reefs and fish and the spirit world mean that reefs can be socially and spiritually unifying.

Whilst these benefit flows sustain the lives of many poor people and stop many more from falling into poverty, their vulnerability to adverse change is increasing. Reef degradation is removing benefit flows, climate change threatens further loss, and well-meaning policies aimed at conserving threatened reefs are often excluding the poor from access to benefit flows or criminalizing that access.

Key actions

Key actions for development agencies include:

Increasing global awareness of: the dependence of the poor on the benefit flows from reefs; shifting from a reef-based conservation focus to a more balanced approach of sustainable use of reef ecosystems that is more people focussed, where the needs and aspirations of poor reef dependent communities are listened to and valued, and where the opinions of the communities are actively sought.

Assisting governments in understanding the potential conflict between different aims of sustainable use of reef ecosystems and assisting them in developing improved policy processes that may harmonise these

varying aims. In particular to focus on the potential role of reefs as a social policy instrument that can support the sustainable livelihoods of the rural poor.

Actively supporting an improved, more transparent, flexible and process-driven approach to the management of reef resources through a partnership between reef stakeholders, including the state, NGOs and local resource users, and across national boundaries, but acknowledging that simple solutions to long-term and complex management problems do not exist.

Supporting the systematic identification and development of viable, sustainable and dynamic opportunities, which will enhance the livelihood security for people who will be excluded from using reefs. This necessitates viewing reefs in the wider, more holistic, context of coastal communities and considering the role of community support systems and safety nets, which complement reef resource in times of hardship or crisis.

Enhancing or maintaining the carrying capacity of the environment by reducing the adverse effects of externalities from other sectors through greater inter-sector and international cooperation at the policy making and policy implementation stages.

Acknowledging the complex and diverse nature of poverty, which often means that the poor are hidden or excluded from interventions and may co-exist in coastal areas of apparent wealth, and the need to adopt more holistic approaches to improve our understanding and targeting of poor and vulnerable stakeholders and ensure their participation in policy development and interventions.

Reorienting research to be multidisciplinary and demand driven, to provide a bridge of knowledge between communities and policy makers through greater participation of reef-dependent communities and use of indigenous knowledge in the research process.

Key documents

1992 Rio Declaration and the provisions of Agenda 21 of the United Nations Conference on Environment and Development www.ecouncil.ac.cr/about/ftp/riodoc.htm

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Wilkinson, C. 2000. Status of coral reefs of the world: 2000. Australian Institute of Marine Science. http://www.icriforum.org/docs/status_reefs_2000.pdf

Talbot, F. and Wilkinson, C. (2001). Coral reefs, mangroves and seagrasses: A sourcebook for managers. Australian Institute of Marine Science.

Bunce, L., Townsley, P., Pomeroy, R., and Pollnac, R. 2000. Socioeconomic manual for Coral Reef Management. Australian Institute of Marine Science.

(Source: www.onefish.org)



Key Websites

IMM's Reef Livelihoods Assessment Project: <http://www.ex.ac.uk/imm/rla.htm>

The Global Coral Reef Monitoring Network (GCRMN): <http://www.gcrmn.org/>

The South Asia GCRMN site: <http://ioc.unesco.org/gcrmn/>

Coral Reef Degradation in the India Ocean (CORDIO): <http://www.cordio.org/>

The WorldFish Center (ICLARM): <http://www.iclarm.org/>



<http://www.photolib.noaa.gov/reef/images/big/reef0453.jpg>

■ FIJI IS SET TO BECOME AN IMPORTANT TRAINING CENTRE FOR FRESHWATER SHRIMP AND MARINE PRAWN AQUACULTURE

In Fiji, the government operated Naduruloulou Research Station and the USP Marine Studies Program are set to become important training institutions in the region for freshwater shrimp and marine prawns. These commodities are attracting much attention in the region. For example in Fiji, there is a strong demand for macrobrachium shrimp which fetches FJD 17–30 per kilogram.

Macrobrachium shrimp training workshop at Nanduruloulou

A hands-on training in aquaculture techniques of the giant freshwater shrimp (*Macrobrachium rosenbergii*) was recently completed at the Naduruloulou Aquaculture Station utilising its hatchery facilities, hostel, laboratory and pond facilities.

A total of 11 persons from 3 countries completed the course. There were seven participants from Fiji (six government staff and one private operator), two

staff from Ministry of fisheries, Vanuatu and two staff from Ministry of Marine Resources, Cook Islands.

The training course was organized by USP's Marine Studies Program (MSP) in collaboration with the Fisheries Department of the Ministry of Fisheries and Forests (MFF) of Fiji. The Canadian South Pacific Ocean Development Project (CSPOD 11) provided funding and sponsored the participation of all 11 participants.

Mr Satya Nandlal from the Institute of Marine Resources (IMR), a commercial arm of MSP, conducted the training.

The duration of the training was one month, from 2–31 March 2003.

University of the South Pacific establishes a prawn hatchery for training

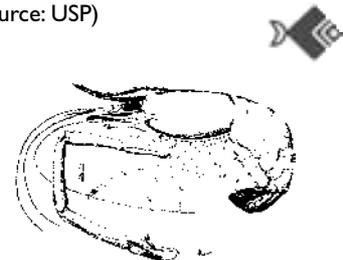
USP has established a giant tiger prawn (*Penaeus monodon*)

hatchery at its saltwater laboratory. The hatchery is a collaborative effort between the university and a private company, Gulf Seafoods. Also received at the hatchery are disease-free broodstock of the western white prawn (*Litopenaeus vannamei*) imported from Hawaii.

According to Dr Pickering, the head of aquaculture at USP, the institution is willing to host trainees from the region who wish to do hands on applied research or gather experience in penaeid hatchery techniques.

A number of ex-USP students from the region have returned to the hatchery as training attachments.

(Source: USP)



■ FSM FISHERIES ASSOCIATION ESTABLISHED

The FSM Offshore Fisheries Association was established following the inaugural meeting of national and state fishing industry and public sector representatives in Pohnpei, Federated States of Micronesia, 10–12 December 2002. Representatives of 18 out of 24 eligible commercial offshore fishing companies attended the meeting along with more than 40 government officials from the States of Chuuk, Kosrae and Pohnpei attended the meeting. The participation of representatives from Yap State was not possible due to adverse weather conditions and subsequent flight problems.

The President of FSM, Mr Leo Falcam, addressed the opening session of the meeting. Newly elected Chairman of the Association, Mr James Movick, who is a Pohnpei-based private fishing operator and business consultant, chaired the meeting. Papers were presented by fishing industry specialists and representatives of statutory authorities involved in serving the needs of the industry. The Forum Secretariat was represented by Mr Henry Sanday, Investment Policy Officer, who spoke on "Regional and International Trade Arrangements Affecting the Offshore Fisheries Industry in the FSM".

The key objectives of the newly established national fisheries association are to:

represent the interests and views of association members, and the commercial offshore fishing industry generally, in all matters of governmental policy relevant to commercial tuna and other offshore fishing operations and business in FSM;

provide a responsible and representative body through which governments and other organisations may obtain the views and partici-

pation of the offshore fisheries industry;

participate in relevant studies, disseminate information, coordinate technical assistance and marketing activities and, organise training for Association members.

The establishment of the association should facilitate business development in the fisheries sector as both the national and state governments would find it easier to consult with the private sector through the association as part of the policy-making process. Funding support

for the meeting was provided under the C-SPOD Fisheries Association Development Grant Scheme, which is coordinated by the Secretariat's Trade and Investment Division.

(Source: Trade Forum, January/February 2003)



■ HELPING TO MANAGE THE BARRAMUNDI FISHERY IN THE FLY RIVER AND ADJACENT COAST OF PAPUA NEW GUINEA

The collapse of the barramundi fishery in Western and Gulf Provinces of PNG in 1985 led to a loss of both food and income for coastal and island communities. Rehabilitation of the fishery is a priority for provincial and national governments. An earlier ACIAR-funded small project initially identified serious gaps in knowledge about the fishery.

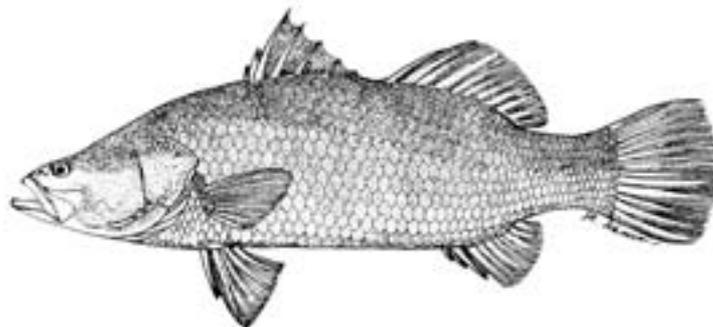
This project has attempted to fill those gaps through studies of the biology, ecology and socio-economics of the barramundi fishery. The ultimate objective has been to assist with the development of a draft Barramundi

Fishery Management Plan for the Fly River and adjacent coastal community.

Conclusive genetic and biological evidence was found to demonstrate that there is only one stock of barramundi living in the Fly River and associated coastal waters. The stock extends into Irian Jaya, thereby constituting a cross-border resource, but it differs from barramundi found in the far east of PNG. This finding was unexpected, based on the predictions from studies conducted in Australia.

Researchers constructed a computer model of the fishery, predicated around searching for a combination of effort controls (size limits, mesh sizes and closed seasons) that would lead to the most efficient use of the available resource. It will be used to investigate how the fishery might respond to variations in distribution of fishing effort among the different communities.

(Source: ACIAR Newsletter, March 2003)



EXPLORING THE POTENTIAL FOR SEAWEED FARMING IN MILNE BAY PROVINCE, PAPUA NEW GUINEA

Introduction

Milne Bay Province (MBP) lies at the far eastern tip of Papua New Guinea (PNG) and is dominated geographically by its marine environment. It has a maritime area of approximately 110,000 km² and contains some of the most biologically diverse and pristine coral reefs, mangrove forests, and seagrass beds in the world (Sekhran and Miller 1994; Piddington et al. 1997; Allen and Werner 1998; Allen et al. in press). The majority of the province's approximately 210,000 inhabitants live in coastal or island communities. They are predominantly matrilineal (i.e. clan membership, territorial rights and inheritance are determined through the female birth line), and rely mainly on fishing, trade and subsistence agriculture for their food security and livelihoods. The pressure exerted on marine resources is increasing given the burgeoning population of the province (currently growing at 2.5% per annum), the increasing desire for cash, the effects of droughts in recent years and the decline in traditional income sources such as copra. Average annual income per household has been estimated at USD 130.00 (Kinch 2001a; Mitchell et al. 2001).

To mitigate the possibility of fisheries decline, there is a need to development alternative livelihoods and income sources

by Jeff Kinch¹, Jane Bagita²
and Minne Bate³

for coastal and island communities. This is considered a prerequisite to achieve sustainable marine resource harvesting in MBP. As a development, seaweed farming requires only a small capital outlay, allows for flexibility of commitment, and has low or nil environmental impacts (see Luxton 2002). Also, the sun-dried product can easily be stored for more than one year, making production particularly suitable for coastal and island communities where transport arrangements may be sporadic. Seaweed farming and other mariculture initiatives can

involve all sectors of the community and is equally undertaken by men, women and the aged; and at an individual, household, group, or community level.

Following a recent study by the Food and Agriculture Organization (FAO), MBP was designated a priority for seaweed farming development in the Pacific (see Luxton 2002; FAO 2002).

Seaweed markets

The continuing success and growth of seaweed farming, particularly for the carrageenan industry (see below) is largely due to the mariculture development of the red seaweed *Kappaphycus/Euchema* spp. The farming of *Kappaphycus/Euchema* spp. has now been established as a successful industry for over 30 years in Southeast Asia — which accounts for 80% of all production — and there is a growing interest within the Pacific. This seaweed has proven to be far superior to other seaweeds due to its ease of cultiva-



Map of Milne Bay Province with shallow water and reefs highlighted (source: CSIRO).

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tion and its tolerance to infection. The availability of the export market, coupled by the short-term nature of the crop (six weeks) and the life-span (two years) of the dried product, makes this particular commodity attractive for development to coastal and island communities. Overall, the industry has shown good sustained growth, and is predicted to continue growing at an average rate of between 5% and 8% per annum (Luxton 2002).

The majority of colloid manufacturers (the extraction of valuable chemicals from seaweed to give viscosity, gel strength and stability to liquids and liquid mixtures) are concentrated in Western countries. Currently three multinational buyers (FMC Biopolymer (USA), CPKelco in Denmark (a division of Hercules Inc. USA) and SKW Biosystems SAS (France)) dominate the market (FAO 2002).

The international marketing of colloids has never been a constraint to any new developments in seaweed farming in the Pacific. In fact, the three multinational processors mentioned above have actively sought and encouraged more production from Pacific Island countries by providing technical assistance, at their own expense, to new producing countries (see below).



Seaweed farming in Kiribati (photo: Mitchell 1998)

Forward supply and price agreements with foreign buyers have been an important factor in the production growth, providing certainty of sales on a world commodity market characterised by cyclic fluctuations in supply and demand. Such agreements not only guarantee the sale of product irrespective of Southeast Asia's production, but also provide the necessary price security and protection for farmers and exporters embarking on a new development. Such agreements inevitably afford some exclusivity to the buyer for a specified term; in return, the producer and exporter benefits from having no marketing costs at the important stage of trying to establish an economic level of production (Luxton 2002).

Uses of seaweed

Extracts derived from seaweed are used extensively in the pharmaceutical and medical industries where they are used for health, dental and skin-care, and in cosmetics; and by food industries, which use extracts as a stabiliser, thickener or gelling agent. "Thalassotherapy" (or "algototherapy") baths has also been revived in recent years and has also developed into a major tourism industry.

Agar

Agar is manufactured from certain species of red algae (Rhodophyta) such as *Gelidium* spp., *Gracilaria* spp. and *Pterocladia* spp. Species of *Gracilaria* are more plentiful, more widely distributed and easier to cultivate than are *Gelidium* spp. and *Pterocladia* spp., which do not readily respond to mariculture conditions, and are not easily harvested as are the carrageenophytes.

Agar is the most expensive of the seaweed extracts, owing to its relative scarcity and its specialised applications. It is able to bind considerable quantities of water to form a gel substance that is soluble in hot water but becomes water insoluble at room temperature. The relative gel strength of agar is four to five times that of any other phycolloid. Its neutral status also enables it to be used extensively as a culture for medical and plant tissue applications. Agar is used in canned pet foods, as a gelling agent in confectionary, and also in the prevention of dehydration of confectionery bakery products. Because it is capable of withstanding the sterilisation process, it is also utilised as a preservative. Agar is the main constituent of microbiological bacterial culture and as such is in high demand within the medical research and development industry. The major focus here is the potential utilisation of polysaccharides for medical treatments for such diseases as cancer, angina, and HIV (the virus that causes AIDS).

Carrageenans

Carageenans are obtained from red seaweeds (Rhodophyta) such as *Gigartina* spp., and some species of red algae, principally *Kappaphycus alvarezii*/*Euचेuma cottonii*, *E. spinosum* and *Chondrus crispus*. Carrageenans resemble agar



Eucheema sp. fresh, dried and gel
(photo: Bate 2002)

chemically but contain a higher ash content and require higher concentrations to form a gel and have the ability to stabilise water/fat emulsions during preparation.

Among all the phycocolloids, carrageenans have by far the widest application in the food industry. They are principally used in ice cream, milk-based foods and drinks, milk and water-based desserts, protein-based foods, and fruit juices. Beverages such as beer, bakery products, dietetic food, dressings and sauces, and frozen food are also among the products that may incorporate carrageenans, acting as thickeners, stabilizers and emulsifiers.

Alginate

Alginate is present in most species of brown seaweeds (Phaeophyta) and is the most widely used seaweed colloid. Alginates are used for their water retentive, gelling, emulsifying and stabilising properties and as low-priced viscosifiers. They are used to prevent water leakage from frozen fish during thawing, or to prevent the degradation of starch. Furthermore, alginates will stabilise oil-and-water emulsions, such as mayonnaise, and suspensions of finely distributed solid material in water, such as some salad dressings. A developing field of application is in restructured

food such as crabsticks and onion rings, and the pimiento stuffing of olives.

General health and nutrition

There are an estimated 100 edible species of seaweed (see Novaczek 2001a, b; Novaczek and Athy 2001) that can

be eaten either raw, dried or cooked and can offer alternatives for better nutrition for coastal and island communities in MBP. The main seaweeds traditionally consumed by coastal and island people of MBP is *Caulerpa* spp., *Sargassum* spp. and *Turbinaria* spp. Depending on the species, seaweeds can contain calcium, iron, agar, carrageenan, algin, iodine, folic acid, vitamins A, B and C, micro-nutrients, laminarin, carotene, potassium, mannitol and fucoidan. These elements or a combination thereof, are beneficial to the human body by: helping lower blood pressure, cholesterol and sugar levels; preventing blood clots; fighting against tumours; removing intestinal worms; treating goiter, bronchitis, stomach ulcers, colds, flus, diarrhoea and constipation; removing shellfish poisoning; inactivating HIV; and removing lead and radioactivity from your body (see Novaczek 2001a, b). Some species can also be dried for use as a dressing for cuts and burns.

Seaweed farming for Milne Bay Province

In late 2001, an international seaweed consultancy firm based in New Zealand conducted a survey in MBP for FAO. Due to time constraints, only the group of islands around Samarai were surveyed, but there are several positive indicators to the socioeconomic viabil-

ity of seaweed farming in coastal and island communities of MBP. This is because initial investment costs are low, farming methods are straightforward and with up to five to six harvests per annum there is rapid return on investment. The level of net household incomes from farming could be expected to be well above the current net household income and will outperform copra production as a cash-earning alternative at particularly fertile sites (Luxton 2002). It can also replace income from beche-de-mer, which is showing evidence of harvesting pressure and decline in some areas (see Kinch 2002a; Skewes et al. 2002) resulting in a more predictable and sustainable cash income from an activity that can fully involve both women and men. Production could also be a part-time activity, allowing time for other activities such as subsistence fishing, gardening, other domestic duties and cultural activities.

MBP was chosen as a priority by FAO because of its geographical diversity. Therefore, a large number of sites could prove to have suitable physical characteristics and potential sites should have the following features:

Large areas (more than 1 ha) of shallow water (1–3 m depth) adjoining or in close proximity to population centres;

Shallow water areas with a soft coarse substrate, with few coral heads;

Exposure to prevailing south-easterly winds, with a fetch distance of more than 5 km to any south-easterly wind barrier;



Protection from direct storm wave exposure by a barrier reef or small islands;

As far away as possible from any freshwater runoff from the land (Luxton 2002).

Kappaphycus/Eucheuma spp. can tolerate sea surface temperatures from 21–31°C, but optimum growth occurs at 26–27°C (FAO 2002) and, therefore, will be probably more suited to areas in southern MBP as Davies et al. (1997) have recorded high sea surface temperatures in the northern MBP, particularly around Goodenough Island, causing extensive coral bleaching.

Areas with strong tidal currents and upwellings are also likely to provide suitable conditions for raft and longline culture at numerous locations as they provide the necessary water movement for growth, but also provide water mixing, which minimises the possible negative impact of freshwater runoff. Fast growth is obtained only where there is a high level of water movement, either from wind-driven wave action or strong tidal currents. Plants in a favourable environment can exhibit rapid growth with mean relative growth rates as high as 10% per day. Shallow-water flats in close proximity to mangrove communities and sea-grass beds limit farming development because of predation from schooling *Siganus* sp. (rabbitfish) (see Luxton 2002).

Site selection for introduction of seaweed farming in MBP could be assisted by the satellite imagery and the environmental data obtained from the 2001 stock assessment for sedentary resources that was conducted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the National Fisheries Authority (NFA), and Conserva-

tion International (CI). This survey collected substrate data at 1126 sites across MBP (see Skewes et al. 2002). This data will be important because many environmental parameters that determine commercial viability can only be ascertained by using the seaweed as a biological indicator of site conditions over at least a twelve month period.

Current activities and expertise

In November 2002, the Secretariat of the Pacific Community (SPC), in conjunction with the Solomon Islands' Department of Fisheries and Marine Resources (DFMR), conducted a seaweed farming workshop. The workshop was funded by the European Union's (EU) Rural Fishing Enterprises Project with assistance from FMC BioPolymer. Mrs Jane Bagita, a Milne Bay provincial Fisheries Officer, was supported by NFA to attend the training as an observer, where she acquired skills in seaweed farming, processing and transfer this knowledge and necessary skills to potential farmers in the field (see Ask n.d.). Since her return, Mrs Bagita has been a driving force in trying to develop seaweed farming in MBP for the benefit of village people.

Mrs Minnie Bate is an herbalist and the Director of Pomins Limited, which produces a range of herbal

medicine products under the trade name Gemins®. Mrs Bate recently attended the Sea Plant Product Development Workshop conducted by Eco-Women and sponsored by the United Nations Development Program (UNDP) and the Sea Plant Workshop as part of the Pacific Sustainable Livelihoods Program. Mrs Bate is the first person in PNG to venture into herbal medicines based on traditional knowledge of plants and is an active member of the Traditional Medicine Workshops, which are conducted annually by the PNG Health Department. The market perception is that seaweed extracts as natural products provide desirable properties for skin and health care. Pomins is currently using *Hydroclathrus* in its Face and Body Care Cream. Because of the lack of availability of *Kappaphycus/Eucheuma* spp.,



Top: Mrs Jane Bagita receives her certificate from EU Advisor Hendriks Smets (source: Solomon Star 2002).

Bottom: Participants at the workshop, Mrs Minnie Bate is fourth from the left in the front row (photo: Bate 2002).

Pomins is currently trying to source it from the Solomon Islands or Vanuatu and wish to see it grown in MBP.

Conservation International (CI) has been contracted by UNDP to execute the Milne Bay Community-based Coastal and Marine Conservation Program (CMCP). The CMCP constitutes the first large-scale marine conservation and resource management initiative in PNG. It is intended to be a 10-year program assisting many communities in village-based marine resource management and conservation activities aimed at the betterment of their livelihoods. CI, as part of this aim, may investigate alternative income generation and seaweed farming and other mariculture initiatives. By providing an alternative income source for coastal and island communities seaweed farming in MBP could actively promote the future success of this program. The Asian Development Bank's (ADB) Community-based Fisheries Development and Management Program and the EU's Rural Coastal Fisheries Development Program are also targeting MBP for fisheries development, which seaweed farming could be subsumed in. CSMC is constructing a multi-purpose hatchery at Samarai Island. The hatchery biologist for CSMC has several years of experience at growing seaweed, mainly *Gracilaria* spp. in Australia as a food source for the abalone fishery. This expertise could be easily utilized with financial and technical support from the above programs.

Environmental impacts

Seaweed farming is environmentally friendly on shallow reef flats because the sandy reef flats that provide suitable sites for off-bottom farming generally have a paucity of marine life

compared with reef fringes, due to the lack of a fixed substrate. Farming structures provide the stable substrate for the growth of seaweed, and enable the large production of organic plant matter in a relatively small area. This controlled increase in primary production increases the food supply and substrate availability for benthic fauna and fishes in and around the farming area. In this respect farms act much like fish aggregation devices (Luxton 2002) and increase local biodiversity and food security for coastal and island communities.

As in agriculture, seaweed farming and other mariculture initiatives will suffer from natural phenomena that cannot be controlled, such as cyclones and El Niño Southern Oscillation (ENSO) events. ENSO influences coastal marine environments because the pressure gradient reverses and becomes negative for a prolonged period with a consequent shift in climatic and oceanographic conditions. This major climatic shift produces change in the established current patterns, causing unseasonal droughts and rains. This aggravates environmental stress and can produce conditions unsuitable for seaweed farming because of higher sea surface temperatures, the reversal of prevailing winds, and increased rainfall.

To develop seaweed farming in MBP there will be a need to initially import seaweed from already producing countries. Seaweed in the Gilbert Islands and Fiji Islands, has for a number of years, been contaminated by a small *Polysiphonia* sp. epiphyte that smothers the host when plants are stressed by poor growing conditions. It is absent in Kiribati and probably from other Pacific Island trial sites such as Vanuatu and Cook Islands. The current stock condition and relative low stock

levels make Vanuatu and Cook Islands unsuitable as "seed" stock exporters. The best opportunity for MBP is to import healthy seed stock by air freight from Bali or possibly Biak (FAO 2002). This will ensure that the *Polysiphonia* sp. epiphyte is not introduced. Holding initial seed stock in land-based seawater systems, such as the multi-purpose hatchery established by Coral Sea Mariculture (CSMC) at Samarai would allow for a close inspection of plants before commencing in situ growth trials. Finally, as only vegetative cuttings are grown, the plant is devoid of any holdfast and consequently cannot attach itself to any natural substrate.

Conclusion and further directions

From both an environmental and a socioeconomic viewpoint, the potential for successful farming development in MBP is far greater than that in other Pacific countries (Luxton 2002; FAO 2002). While the marine environment of MBP is currently in an excellent and mostly pristine condition, overharvesting of some marine resources and the decline in traditional cash crops causes concern for the future. Developing alternative income sources is particularly important now, as a recent stock assessment revealed that some species of beche-de-mer and giant clam are heavily overfished in some localities (see Skewes et al. 2002; Kinch 2001b, 2002a, b).

Seaweed farming is an environmentally sustainable activity, and has the potential to reduce the catch of marine resources for income generation. Any new income source in coastal and island communities is also likely to reduce the future need for some to resort to illegal (such e.g. hookah gear) or destructive harvesting of marine resources.

Seaweed farming has been shown to provide a better return for effort than copra production on other Pacific Islands, and the same would be true for MBP for those communities with suitable habitat nearby (Luxton 2002).

Successful development in MBP will take two to five years and require considerable financial assistance. This could be sought through the forthcoming ADB, EU or CI programmes with cooperation from the PNG national and provincial government fisheries, private enterprises such as CSMC, and other organisations such as the CSIRO, Queensland Department of Primary Industries, Environment Australia, FAO, SPC and the WorldFish Center. This would also promote regional cooperation on technical aspects of seaweed farming in the Pacific.

Currently, the MBP has a small private sector, with few local entrepreneurs having the necessary capital or experience to risk investing in a new unknown commodity. There will therefore be a need to establish the business infrastructure and/or support from the private sector at the outset of any commercialisation programme. CSMC, or current dried marine resources exporters such as Kiwali Exports, Asiapac and RFI, could be involved. Alternatively, NFA in conjunction with the Milne Bay Provincial Fisheries Division could negotiate with multinational buyers, though given the past performance of government involvement in business, this avenue is not overly satisfactory. Getting exports to market should not represent any problems because there is a very accessible shipping freight system and existing port facilities at Alotau and Samarai. Subsequently the most cost-effective export freight rates could be

expected by back-filling boxes to Sydney for onward shipment to processors in Europe or Asia (Luxton 2002).

Before there is any development in seaweed farming there will be a need to conduct an assessment of alternative livelihood options, identification and scoping of possible seaweed farming and mariculture projects, followed by the implementation of a pilot seaweed farm as an alternative livelihoods project. This is deemed necessary because it may take several years to build farmer confidence in a completely new activity, and change work habits away from more traditional income-earning activities, such as copra production and beche-de-mer collection. There would also be a need to undertake site selection surveys and establish and monitor growth rate trials to introduce *Kappaphycus/Eucheuma* spp. at selected sites. There will also be a need to development further education and training in identifying different plant responses and morphological changes, and to analyse lessons learned from other project areas. Finally, it is vital that any alternative livelihoods project based on seaweed farming or other mariculture initiatives, be well supported by adequate and continuing funding. This would have a positive effect in reducing poverty and protecting the marine environment of MBP by reducing reliance on declining marine resources.

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SAFETY ASPECTS OF SCUBA DIVING IN PACIFIC ISLAND FISHERIES DIVISIONS: LESSONS TO BE LEARNED

Note from Editor: This article was originally published in the SPC Fisheries Newsletter #61 (April-June 1992), which is now out of print. Several of our readers have asked us to reprint this article.

by Leslie Farnel
and Robert Gillett

Introduction

In recent years there has been a tremendous increase in scuba diving by fisheries division staff in the Pacific Islands. National and regional training courses for fishery personnel have been sponsored by several donor agencies and have resulted in the training of a large number of staff. This has enabled local staff to perform tasks that previously were carried out by expatriate personnel.

As with the introduction of any new technology that contains some degree of physical danger, there have been problems. In some Pacific countries fisheries division staff have been involved in accidents. In others, unsafe diving practices could easily result in a disaster. Some equipment used is inadequate for the tasks while other gear is in poor condition.

Because the United Nations fishing programmes in the Pacific have had a major involvement in scuba training for fisheries work, there has been an obligation to follow up the initial instruction. Accordingly, the FAO/UNDP Regional Fishery Support Programme sponsored in the late 1980s, early 1990s scuba safety workshops in the fisheries divisions of six Pacific Island countries in

which the diving practices of approximately 75 divers were reviewed.

With the experience gained from carrying out these workshops, a number of generalizations can be made. Although there are differences between countries with respect to scuba diving practices, there are many common hazards, concerns and dangerous situations. The following is an attempt to consolidate observations on unsafe practices in order to decrease the risks associated with fisheries division diving.

Rapid ascents

In the Pacific Islands the most serious common scuba problems are caused by rapid ascents to the surface. This is most often due to an unforeseen air depletion situation, but also occurs as a result of panic, usually from environmental threats such as sharks or strong currents. Correct ascent rates are between 40 to 60 feet per minute (12 to 18 metres/minute), with a three to five minute safety stop on all dives at 15 feet (5 metres) below the surface. This stop should be made regardless of how shallow or how short the dives are. Some divers feel that shallow dives for relatively short times require no stop. This is not true.

Rapid ascents can cause lung over-pressure problems from

pressure differences between the air inside the lung and the water on the outside of the body. Rapid ascents, especially ones where divers do not exhale, can cause overexpansion and rupture of lungs due to trapped air. Air embolism is the most serious lung overpressure disorder and results in air bubbles being trapped in the circulatory system. This may produce central nervous system damage such as permanent paralysis, brain damage or heart attack. Another serious problem associated with rapid ascents is decompression sickness, also known as the bends. While there is always a risk of bends with any use of scuba, regardless of depths and times, rapid ascents greatly increase this possibility. Nitrogen bubbles in tissues occur, causing pain and numbness, resulting in central nervous system disorders.

During the scuba safety courses, it was noted that a surprising number of former scuba divers were no longer able to dive due to ear damage. It is likely that many of these problems originated from rapid ascents or improper equalization techniques.

Running out of air

As indicated above, a major cause of rapid ascents is simply running out of air. Much more attention needs to be given to having properly functioning gauges and diligent monitoring of the gauges to prevent serious injury.

Not only is running out of air bad for the diver but the equipment suffers as well. With the last breath of air from a tank, a vacuum is created and water enters the regulator and cylinder. It can damage seals, corrode hoses internally, cause gauges to read incorrectly, and produce corrosion in the cylinder.

der, which could result in unsafe air for breathing or cylinder failure. This could be prevented, firstly by taking measures not to run out of air or, failing that, having regulators cleaned, seats replaced, and cylinders cleaned each time the situation occurs.

Use of dive tables

The use of dive tables or other means of keeping track of nitrogen uptake is very important in reducing the possibility of decompression sickness. In several of the Fisheries Divisions no tables or other methods are employed. Either no training has been given or that which was has been forgotten. In some places tables are used incorrectly. Dive tables are based on comprehensive research, experience, and manufacturer's rules of operation and must be followed for safe diving. An additional problem relating to dive tables is that some divers are attempting to devise multilevel dive plans from tables designed for single depth dives.

It should also be noted that even the use of dive tables or a dive computer does not entirely eliminate risk. Many divers are at risk for bends if they stay for long periods even in shallow water. Multilevel dives, where divers start deep and gradually work to shallower depths, should only be undertaken with great caution. While a computer may indicate this is theoretically possible, other factors such as the diver being tired, dehydrated, hung-over, or sick cannot be considered by the computer and can increase the risk of decompression sickness. In fact, recent research indicates that as much as 60% of the people getting bends are using computers. Even more surprising is that, of bends victims treated in Honolulu, 49% were from dives within the limits of the US Navy

tables, 29% within the PADI Recreational Dive Planner and 21% within NAUI tables. The conclusion is that not only should tables be used, but they should be used conservatively and in consideration of factors affecting the diver's fitness.

Multi-day repetitive dives

Many fisheries division divers are doing research on clams, sponges, pearl oysters or fish stock assessment, which involves diving long hours for several days in a row. At present there are no tables or dive computers that can account for this type of diving. Multi-day repetitive divers are at high risk for bends. Additional negative factors such as getting cold because of ill-fitting wetsuits or lack of wetsuits, multiple ascents, tiredness and dehydration, which are common factors in fisheries-related diving, further increase the risk. It is now recommended by many experts to dive no more than two dives per day, no more than three days in a row, and wait 24–48 hours before going to a high altitude or travelling in an airplane. It should be noted that this recommendation will modify many scuba work programmes in fisheries divisions.

Lung fitness

Lung over-expansion injuries as described earlier can also be caused by air trapped in unfit lungs such as in divers with asthma, bronchitis, chronic cough, colds, flu, lung cysts, history of punctured or collapsed lung, etc. Certain lung disorders should therefore preclude diving, either temporarily or permanently. These disorders can cause air trapping even though the ascent and breathing pattern of the diver is normal. It was found that many divers interviewed in Pacific Island dive

safety courses were diving despite these lung conditions. An annual scuba-oriented physical examination should be required for all divers.

Recreational drug use, smoking and drinking

In many areas divers use recreational drugs such as kava or betelnut before and after diving. No research has been done on how these activities affect diving. Impaired judgement is, however, a likely side effect. In addition, it is not known what effect these substances, combined with pressure and nitrogen, may have on a diver. It has been determined that certain drugs such as nitrous oxide increases tissue loading. The use of kava or betelnut in conjunction with diving is therefore not recommended.

A surprising number of Pacific Island divers smoke and drink without knowledge of the scuba-related side effects. Drinking and smoking both cause peripheral vaso-constriction increasing the possibility of hypothermia and reducing proper release of nitrogen. Drinking also causes dehydration and, combined with a touch of seasickness, hangover, and heat increases bends risk. A substantial number of Pacific Island cases of the bends are listed as "complicated by alcohol". Smoking increases risk of lung over-expansion, due to a general weakening of the lungs and coating of alveoli, which prevents proper gas exchange. Gas poisoning can occur as the partial pressures of the surface-inhaled carbon monoxide increase on descent. The possibility of heart attack (the number one killer of divers) is increased with smoking. Divers should refrain from these activities before diving and for about four hours afterwards.

Many fisheries division divers were unaware that certain prescription and non-prescription drugs, such as those used for asthma and high blood pressure, can cause fatal side effects when combined with scuba diving. Unless confirmed with medical authorities that a particular drug is safe, nobody taking medication should be allowed to dive.

Equipment problems

Although the cost of obtaining new gear was cited by fisheries officers as being a major difficulty, many of the equipment problems observed could be easily avoided through preventative maintenance and proper storage of gear. Regular servicing by a qualified technician and record keeping of this servicing are only done in a few fisheries divisions. Tanks stored on a wet cement floor (increases corrosion), wet suits dripping on tanks (corrosion), and regulators hanging so that hoses are bent (wear) were commonly observed. To avoid having debris accumulate, cylinders should never be completely drained, but stored with a minimum of 300 to 500 PSI (50 bar).

Ill-fitting wet suits and inadequate buoyancy regulation were common equipment problems. Using a wet suit that is too large (or not using a wet suit in cool water) can cause a diver to become cold and subject to hypothermia, increasing the risk of bends. If a wet suit is too small, it can restrict blood flow causing nitrogen accumulation in tissues. Buoyancy regulation problems that were noted included inadequate weighting, total absence of buoyancy control devices (BCs), and BCs that self-inflated, possibly causing a rapid ascent. Because of these buoyancy problems, many fisheries division divers complain of fatigue. Exertion increases

the risk of bends, can cause panic, and can result in an inability to maintain safe depths and perform safety stops when surfacing.

The condition of the scuba tanks causes some worry. Tanks containing dead wasps, water/oil, green algae, or corrosion were noted in almost every fisheries division. The number of cracked/corroded/uninspectable tanks was also quite large. A scuba tank that explodes could easily destroy the building in which it is stored or knock over a large bus.

The air quality inside tanks is very important. Debris inside tanks, compressor filter problems, and improper compressor air intake arrangements were astonishingly common in the fisheries divisions. Bad air can cause headache, nausea, vomiting, breathing difficulty, blurred vision, or even death.

It should be stressed that the most serious equipment related problem in the Pacific Islands is misuse. Specifically, not using gauges, paying no attention to dive tables/computers, and improper storage/maintenance of gear.

Shallow-water blackout

Although shallow-water blackout is experienced by free divers and is not a scuba accident, a significant number of these accidents were noted during the safety work, and a mention should be made. Extreme hyperventilation prior to descending alters the carbon dioxide to oxygen ratio in the body tissues and reduces the breathing-triggering mechanism. This could cause unconsciousness on surfacing and subsequent drowning, heart attack or the diver being lost in strong currents. This possibility is increased if the diver practises

multiple descents in rapid succession. Certain free divers, especially those involved in pearl culture, who remain for long periods underwater repetitively, can be subject to decompression sickness even though they are not using scuba. To reduce this possibility there should be a rest period between dives and no more than three hyperventilation breaths should be taken.

Shark attacks

It was somewhat ironic that the primary safety concern of participants involved in scuba workshops is actually not very important statistically. For the 75 divers attending the workshops, shark attacks were perceived as the greatest safety hazard. Evidence of shark attacks on scuba divers was, however, non-existent in any of the countries where workshops were carried out.

Safety awareness of supervisors

The scuba safety courses sponsored by FAO were generally well attended by mid-level staff of the fisheries divisions. The supervisors of the diving staff, however, were frequently not present for these courses. Although the divers may have become more safety conscious, in some cases it appears as though they were required to return to the same potentially risky environment because those directing the work were unaware of unsafe conditions. The effectiveness of the training is obviously limited if the individuals must go back to former practices. In addition, misunderstandings can occur when a supervisor unknowingly asks a worker to perform in such a manner learned to be unsafe from the training. It is therefore important that the diving supervisors be at least as well

informed on safety aspects as the divers themselves.

Established habits

Many fisheries division divers, especially older ones, are reluctant to change their ways. Although they acknowledge the value of updated information and agree that some of the new practices pose less risk, they insist their practices have served them well in the past. Because they have experienced little difficulty from these habits, they see no need to change. Many older divers feel new guidelines are oriented to the casual expatriate sport diver and do not apply to those that dive much more often. The problem with this philosophy is the cumulative long-term effects of diving, especially from multi-day repetitive dives over many years, combined with disregard for safe depths and times. This can place the older and more experienced divers at a higher risk for degenerative dive-related diseases such as bone necrosis, bone marrow cancer, retina, liver and neurological disorders and various types of anaemias. Experience in the Pacific Islands has shown that a relaxed attitude towards established scuba safety practices can be very dangerous.

Lack of current information

A related problem is that some divers who attempt to adhere to updated diving standards have difficulty obtaining current information. Many divers were certified some years ago, but recently much research has been done. This new work, especially in the areas of nitrogen uptake and physiology, shows that many of the diving "rules of thumb" are not valid. For example, the old theory that decompression sickness is not a problem in less than 10 metres (33

feet) of water, or that the bends cannot occur on only one tank of air has been disproven. Until just recently, little research on the effects of diving had been done since the US Navy's World War II work. With better data and superior ways of processing information, scientists are now making important conclusions on health and safety aspects of diving, which are having a major effect on scuba practices. Examples of this are: the relationship between flying and diving in the same 24-hour period, dehydration and lack of sleep causing the bends, the discovery that diving in depths of eight meters can cause the bends, and that multi-day repetitive diving increases the risk of brain damage.

It is unfortunate that little of this current information is brought to the attention of scuba divers in the Pacific Islands. In this region diving periodicals are expensive and difficult to obtain. Even qualified scuba instructors who are on such mailing lists get their information irregularly. International agencies dedicated to diving safety such as National Association of Underwater Instructors (NAUI), Professional Association of Diving Instructors (PADI), Divers Alert Network (DAN), and Divers Emergency Service (DES), often feel the Pacific is a geographic nightmare to service and that there are not enough people in the area to warrant attention. There is clearly a need for some agency based in the Pacific Islands to obtain and disseminate current scuba diving information.

Conclusions

From the six scuba safety workshops sponsored by the Regional Fishery Support Programme, certain common features are apparent. Serious accidents are most often caused by rapid ascents and disregard for time spent at depth. In almost all cases these were caused by diver error and therefore avoidable. A more diligent and conservative use of dive tables in conjunction with more rigorous monitoring of gauges could eliminate many serious accidents. Improper maintenance of gear, rather than the lack of gear, appears to be the most important equipment problem. A constant, ongoing attempt should be made to stress the importance of safety aspects of diving in order to prevent a relaxed attitude. In this regard, it may be useful to circulate these notes to all fisheries division divers and to post the boxed information on a notice board.



<http://www.photo.lib.noaa.gov/nurp/images/big/nur05527.jpg>

Safe Diving Practices

1. Understand and adhere to your dive tables. Always do deeper dives first and successive dives shallower. Be conservative and build in safety factors.
2. Ascend at 18 metres (60 feet) per minute or slower. Always stop at 5 metres (15 feet) for 3 to 5 minutes. Avoid altitude or flying for at least 24 hours after diving.
3. Never hold your breath while scuba diving. Never dive when under the influence of drugs, alcohol, when hung-over, dehydrated, or sick, especially if the illness affects circulatory or respiratory functions. Always equalize ears early and often. Cancel dives that you consider unsafe.
4. Always maintain your equipment and check it before and after each dive. Have repairs made a minimum of once a year. Never run your tank completely out of air.
5. Be aware of dive planning. Prior to diving establish the maximum depth, maximum time, minimum air, communications and a buddy system. Always follow your plan.
6. It is always wise to have oxygen available at every dive site. At the very least, divers and those that supervise diving operations should be aware of the nearest source of medical oxygen, as well as the nearest recompression chamber, nearest physician with experience in scuba disorders, and medical evacuation procedures.
7. Restrict dives to a maximum of two per day. Take 24 hours off from diving after every third day. Always allow one hour or more between dives.
8. Understand and control your buoyancy. Always use a BC and do not overweight yourself. Rest when you are tired.
9. Always dive with a buddy; never separate, even on ascents. Practice emergency procedures and dive skills together at least every three months. A boatman trained in emergency procedures should be at the surface during all dives.
10. Upgrade training whenever possible and keep current in knowledge and skills. Share your knowledge with appropriate local authorities, government officials and medical personnel.

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