Spearfishing in the Pacific Islands

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Current status and management issues

by

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Global Partnerships for Responsible Fisheries (FishCode)

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Foreword

This report was prepared by Robert Gillett and Wayne Moy, on the initiative of the Secretariat of the Pacific Commission (SPC) and with the support of the FAO FishCode Programme, under Project GCP/INT/823/JPN, "Responsible Fisheries for Small Island Developing States". The document presents the findings of the SPC/FAO-FishCode Pacific Islands Spearfishing Study, including a review of spearfishing in selected countries, the major problems related to spearfishing and possible interventions to mitigate such problems in the Pacific Islands countries.

The *FishCode Review* series publishes results of studies, missions, consultations, workshops, meetings and other project activities undertaken through the Programme, in furtherance of the objective of facilitating implementation of the 1995 FAO Code of Conduct for Responsible Fisheries and related international fisheries instruments and plans of action. Individual issues in the series are distributed to appropriate governments, regional bodies, meeting participants and Programme partners. For further information on Programme background, publications and activities, please consult the Web site at **http://www.fao.org/fi/fishcode.htm**

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ABSTRACT

Spearfishing is growing in importance in the Pacific Islands. While its management has featured as a topic in some regional-level meetings, detailed information on spearfishing is surprisingly scarce. In early 1994, the Secretariat of the Pacific Community (SPC) proposed to consolidate information on spearfishing in the Pacific Islands. The original intent was to undertake a review of the available literature through a desk study. With the realization that many issues related to spearfishing are undocumented, the strategy was changed to include some field work. These activities were supported by the FAO FishCode Programme.

This report reviews spearfishing in selected Pacific Island countries and identifies the important species caught by and the major problems associated with the method. It further considers possible interventions to mitigate these problems and the assistance that is likely to be required by Pacific Island countries in the management of their spearfisheries. Visits to five countries undertaken during the study show that there are very large differences between countries, and between locations within a single country, in the level and type of spearfishing activities. General conclusions on the management of spearfishing include: (a) for several reasons, a complete ban of scuba spearfishing coupled with effective enforcement is the single most important spearfishing management measure; (b) spearfishing effort must be managed along with other forms of inshore fishing, since attempts at restricting spearfishing alone are not likely to be successful as fishing effort may be easily transferred to other small-scale fishing methods; and (c) in the management of inshore fisheries, including that of spearfishing, interventions must be formulated, initiated and enforced at the local level, preferably with some assistance from the national level.

Keywords: coastal fisheries; marine fisheries; small-scale fisheries; traditional rights; small island developing States; South Pacific, illegal, unreported and unregulated (IUU) fishing.

Contents

Abbreviations and acronyms

AusAID	Australian Agency for International Development
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CPUE	catch per unit of effort
DMWR	American Samoa's Department of Marine and Wildlife Resources
FAO	Food and Agriculture Organization of the United Nations
FCA	Funafuti Conservation Area
FFA	Forum Fisheries Agency
GBR	Great Barrier Reef
GPA	Gillett, Preston and Associates
IUCN	International Union for the Conservation of Nature
IWP	International Waters Programme
JICA	Japan International Cooperation Agency
MPA	marine protected area
NGO	non-government organization
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
USP	University of the South Pacific

EXECUTIVE SUMMARY

The SPC/FAO-FishCode Pacific Islands Spearfishing Study

The purpose of this report is to review spearfishing in selected Pacific Island countries, identify the important species caught, ascertain the major difficulties caused by spearfishing, explore interventions to mitigate the problems, and consider the assistance likely to be required by Pacific Island countries in the management of their spearfisheries.

Approach to the study

Several days of fieldwork were undertaken in each of five Pacific Island countries: Fiji, Tonga, Samoa, Tuvalu, and the Solomon Islands. Additional spearfishing information was obtained from other Pacific Island countries, developing island countries in the Indian Ocean and Caribbean and from available literature.

Important spearfishing issues in Fiji

- Commercial spearfisheries depleting fishery resources in areas which may be quite important for village food supplies.
- The low priority given to enforcing legislation related to spearfishing
- The exclusion of "spearing" from commercial fishing activities that require a licence, and the exclusion of "spearing" by outsiders from activities that can be regulated by traditional authorities under the Fisheries Act
- The difficulty of collecting evidence required for a successful prosecution of fishing with scuba gear
- The difficulty of villagers enforcing rules on fisheries activities that mainly occur at night
- The incompatibility of marine-oriented tourism and spearfishing, or at least commercial spearfishing
- The health risks of scuba to untrained divers
- The use of large "fish collection vessels" in conjunction with spearfishing.
- The targeting of fish spawning aggregations by spearfishers

Important spearfishing issues in Tonga

- In Tonga's open-access regime there is some concern that nothing practical can be done about the excessive fishing effort, a major element of which is spearfishing.
- There are very few controls on spearfishing, and very lax enforcement of ones that do exist.
- Although the use of scuba for spearfishing appears to be contained, there is some worry that the situation may change if the beche-de-mer fishery and associated scuba use re-commence.
- It is difficult or impractical to collect the evidence required for a successful prosecution of using scuba for spearfishing.
- Some individuals are concerned about the long-term impacts of visits by industrial-scale spearfishing operations to Tonga's isolated reef areas.
- Spearfishing inside the fish fences for fish, which other people considered have already been "caught" is growing.

Important spearfishing issues in Samoa

- Balancing the need to protect Samoa's inshore fisheries from the deleterious effects of spearfishing with the political directive to allow the existing group of spearfishers to continue.
- Reconciling the village by-laws (which may ban scuba spearfishing) with the national level de facto permission granted to a group of scuba spearfishers
- The difficulty of reducing fishing effort from a variety of inshore fishing techniques, the most important of which is spearfishing.
- Whether the export of inshore fisheries resources (an important component of which is the catch from spearfishing), is justified.

Important spearfishing issues in Tuvalu

- There is sometimes conflict between spearfishing and other gear; the contention that spearing reduces the amount of fish available for line fishing.
- The complexity of reducing Funafuti inshore fishing effort
- The concept that there are limits to inshore fisheries production is new to many Tuvaluans
- The perception by some government officials that any controls placed on inshore fishing (including spearfishing) by the Fisheries Department could be thought by the general public as being contradictory to the Fisheries Department's development efforts.
- The increased algal growth in the lagoon area around the populated centre of Funafuti could be, at least partially, as a result of the removal of herbivorous fish by spearfishing.

Important spearfishing issues in the Solomon Islands

- Fishing is an important component of inshore fishing effort and, even in areas away from the urban centres, there is the perception that inshore resource are declining due to fishing pressure.
- Nighttime spearfishing with flashlights is having a major impact on parrotfish and spawning aggregations of groupers.
- There is considerable concern about coral damage while spearfishing.
- At least some fisheries officers feel that spearfishing is wasteful because of the damage to fish flesh and because a spear hole results in faster bacterial decomposition.

Other Pacific Island countries

Attempts were made through correspondence to acquire information on spearfishing and its management from Pacific Island countries besides those visited (Fiji, Tonga, Samoa, Tuvalu, and the Solomon Islands). These responses are summarized in Appendix 1. Some important features are:

- Spearfishing appears important in all Pacific Island countries and territories. In no country is spearfishing unimportant, nor does any country completely ban spearfishing like some countries in other regions of the world.
- Other than bans on the use of scuba for spearfishing, there appear to be few, if any, national level rules that apply specifically to spearfishing.
- In some of the more affluent countries/territories of the region (e.g. Guam, New Caledonia, parts of the Cook Islands) recreational spearfishing is quite important.
- Research on aspects of spearfishing by the government fisheries agencies has been carried out largely in the French and American territories. Most of the research relevant to spearfishing in independent countries has been undertaken by NGOs or as academic research.

American Samoa and Satawal, FSM

Information on spearfishing obtained from two locations was especially informative and provided some insight as to the justification for management intervention in spearfishing in two very different environments.

PROCFish-C

PROCFish-C is an SPC project that is establishing a regional database on the current status and the current user level of reef and lagoon resources and possibly identifying useful indicators to help improve subsistence and small-scale artisanal fisheries management in Pacific Island countries. While spearfishing is not the focus of the project, information on spearfishing activity has been collected during the project's socio-economic field surveys. The rural/subsistence orientation of the PROCFish/C socio-economic surveys is useful in the context of the SPC/FAO-FishCode Spearfishing Study. The PROCFish/C focus complements the information collected during the field visits of the spearfishing study, which were to some extent oriented to urban/commercial spearfishing, with the combined result being a more accurate overview of the spearfishing situation in the region.

Industrial spearfishing

Spearfishing is generally thought of as a small-scale fishing activity. But what about a 40 metre vessel with dozens of spearfishers? This sort of operation may not be rare in the Pacific Islands region.

Spearfishing in the Indian Ocean and the Caribbean,

From the limited information obtained on spearfishing in the Indian Ocean and the Caribbean, a few comments can be made. It appears that there are generally more restrictions on spearfishing in the islands of the Caribbean and Indian Ocean than in the Pacific Islands. The tourism industry seems to have had an important role in promoting these restrictions. It should be noted that the influence of indigenous people is much reduced or absent in the islands of the Caribbean and southwest Indian Ocean.

Species composition of the spearfishing catch

Some observations can be made on the species composition of the spearfishing catch in several studies cited: These include:

- The families Acanthuridae and Scaridae seem to be responsible for most of the spearfishing catch in most of the studies.
- The families Siganidae and Serranidae seem quite important in a limited set of countries, but apparently much less important in others.
- A large number of other species make up the remainder of the catch.

Selectivity of spearfishing

The notion that selectivity is "good and virtuous" arises from the assumptions that through selectivity, (a) discards are reduced/avoided, and (b) species that can support fishing pressure can be targeted. This "virtue" concept is less relevant in fisheries where there are no discards, or where fishers are selecting for species that cannot support the pressure. The available information indicates that, despite spearfishing gear having selective qualities, the gear is used rather non-selectively.

The selectivity of spearfishing as compared to gillnetting

- A limited amount of information suggests that spearfished catches are made up of slightly more fish families or species than that of gillnetting.
- It appears that a more crucial issue than selectivity in comparing spearfishing to gillnetting in the Pacific Islands is whether the specific fish populations exploited by the particular gear can support the fishing pressure.

Sources of fishing mortality for the main spearfishing species

A catch/gear survey in Tonga shows that spearfishing is responsible for almost all of the fishing mortality on six out of the seven species commonly targetted by that method; about half of the groupers were caught by methods other than spearfishing.

The catch of low trophic level herbivorous fishes by spearfishing

- The Tonga study indicates that, for the herbivorous fish common in the inshore catch, spearfishing is much more important than line fishing as a source of fishing mortality.
- The removal of herbivorous fish from an area can cause serious problems associated with increased algal growth

Major difficulties with spearfishing

The ten most important spearfishing difficulties appear to be the contribution of spearfishing to inshore overfishing, the use of scuba in spearfishing, night spearfishing, industrial spearfishing, negative interaction with line fishing, poaching and difficulties of surveillance, devastation of certain species, devastation of spawning aggregations, incompatibility of spearfishing with marine tourism, and increased algal growth due to the removal of herbivores.
Table 10 summarizes these difficulties and lists some successes/failures in their mitigation.

The contribution of spearfishing to inshore overfishing

The problem of inshore overfishing is complex and there are no easy solutions. With respect to spearfishing, important points are:

- Management interventions dealing spearfishing alone are unlikely to be effective at addressing inshore overfishing; a rather, spearfishing must be treated as one of many fishing methods that contribute to the problem.
- An appropriate role of the national fisheries agency seems to be in facilitating the effort reduction process and providing information to communities, rather than attempting active management.

Scuba spearfishing

Problems include reducing fish populations to low levels and diminishing or eliminating the positive effects of deep water acting as a sanctuary for fish. Also important is that, despite the best attempts of government agencies, allowing the use of scuba in small-scale fisheries will inevitably result in the use of that gear by unqualified and/or careless people and the accompanying risk of injury and death.

What works in the management of spearfishing?

Suggestions are offered on three levels:

- What seems to mitigate specific problems
- What general types of rules and regulations work
- Some specific examples of management interventions that have apparently been successful

Responsive management needed

Not only does enforcement of existing legislation relevant to spearfishing need to be more rigorous in most countries, but as new spearfishing issues arise, measures to deal with these issues need to be explored, promoted, and championed to fruition.

FAO Code of Conduct for Responsible Fisheries

- The FAO FishCode Programme provided about two-thirds of the funding for the Pacific Islands Spearfishing Study. It was therefore thought appropriate to identify Code of Conduct issues that are especially relevant to spearfishing in the Pacific Islands.
- Much of the Code is applicable to spearfishing in the Pacific Islands. Sections of particular relevance are identified.

A special SPC initiative on spearfishing in the future?

As an alternative to a having a special spearfishing initiative, another strategy that may warrant consideration is to analyse the array of important coastal fisheries management issues, determine the areas where regional and national expertise is lacking, and carry out several specialized “mini-initiatives” in those areas.

1. Introduction

1.1 Background

Spearfishing is growing in importance in the Pacific Islands. It was almost insignificant in the region prior to the introduction of diving goggles in the middle of the twentieth century. Now the fishing method is one of the major components of inshore fishing in the Pacific Islands. Spearfishing is also a major contributor to what is arguably the greatest fishery problem in the Pacific Islands – excess inshore fishing effort and associated resource declines. On the positive side, spearfishing produces much of the local marine food available to Pacific Islanders.

Despite this importance, detailed information on spearfishing is surprisingly scarce. Although there are numerous descriptive accounts of spearfishing in the 22 countries and territories of the region, there is a paucity of information on the major issues associated with spearfishing. Other fisheries, such as that for the live fish trade, often catch the same species, but are far better studied and documented than spearfishing.

The management of spearfishing has featured in some of the regional-level meetings in the Pacific Islands. These include the 1999 SPC Heads of Fisheries Meeting and the 2000 International Coral Reef Initiative Regional Symposium. Although these discussions have been generally inconclusive on the subject of spearfishing, one common feature to emerge is the need to know more about the management of spearfishing, especially the regulatory experiences of the various countries.

In early 1994 the Secretariat of the Pacific Community proposed to consolidate information on spearfishing in the Pacific Islands region. The original concept was to undertake a review of the literature through a desk study. With the realization that many spearfishing issues are undocumented, especially those concerning recent developments and regulatory experience, the strategy was changed to include some fieldwork. Additional funding was obtained through the FAO FishCode Programme to allow a limited number of country visits.

This report presents the findings of the SPC/FAO-FishCode Pacific Islands Spearfishing Study. The purpose of the report is to review spearfishing in selected Pacific Island countries, identify the important species caught, ascertain the major difficulties caused by spearfishing, explore interventions to mitigate the problems, and consider the assistance likely to be required by Pacific Island countries in the management of their spearfisheries.

1.2 The spearfishing study

SPC commissioned a study in which the following activities were specified:

- Searching the literature for published and unpublished documents to spearfisheries and their management.
- Contacting fisheries specialists in several Pacific Island countries to determine the extent of spearfishing activities, concerns about the fishery, any applicable legislation, and associated management measures.
- Communicating with knowledgeable individuals in other regions and in international organizations on spearfishing-related issues.

- Conducting field visits in a few Pacific Island countries to gather information on the fishery, including species captured, extent of fishing, production, sustainability issues, economics, and other topics.[1]
- Analysis of the data and reporting.

Work on the spearfishing study commenced in late October 2005 when literature searches were conducted and specialists contacted. This was followed by field visits to locations in Fiji (27 October to 4 November), Tonga (5 to 8 November), Samoa (8 to 12 November), Tuvalu (15 to 20 November), and the Solomon Islands (24 to 29 November). Recognising the shortcomings of personal observations made only at locations close to urban centres, a University of the South Pacific (USP) student was contracted to obtain spearfishing information in September and October in rural areas of southwest Vanua Levu, about 180 km north of Suva, Fiji.

The report of the study is not a comprehensive document on spearfishing in the Pacific Islands, but rather is focused on topics specified by SPC. These are:

- The current status of commercial spearfishing in the Pacific Islands: (What sets of species are targeted? What complaints, and worries are expressed by the various countries? What are possible management measures?).
- The significance of spearfishing in comparison to other sources of fishing mortality for the target species.
- The selectivity of spearfishing as compared to gillnetting, and the ability to take low-trophic level herbivorous fishes compared to hook and line fishing.
- Code of Conduct for Reponsible Fisheries issues relevant to spearfishing.[2]
- The regulatory, policy, or traditional measures that have been taken: (What has been effective? What general management advice can be given?).
- The value of launching a special regional initiative on managing spearfisheries.

1.3 Some methodology considerations

There are several possible sources of national information on spearfishing. These cover the spectrum from use of established statistical systems to one-off "snapshot" surveys, more in-depth surveys or studies, collection of anecdotal information from government fisheries departments, fishers, and others, and direct personal observations during field work. During the field work for this study, attempts were made to obtain information from the most reliable sources possible. Ideally, information for the study would come largely from reviewed documentation, but due to a paucity of such formal sources, it was necessary to rely to a great extent on discussions and personal observations.

In addition to the five Pacific Island countries visited, attempts were made to obtain information from the other seventeen countries and territories of the region. For most of those places, one official of the government fisheries agency and one non-government individual were contacted. Responses were received from most of the countries. Because the emphasis of this report is on management issues, no attempt was made to fully describe the spearfisheries in the non-visited countries. Unless the responses contained significant

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[1] For reasons of economy and to include a variety of conditions, the countries Fiji, Tonga, Samoa, Tuvalu and the Solomon Islands were to be included.

[2] The Code of Conduct for Responsible Fisheries was unanimously adopted by FAO member states in October 1995. Together with its Technical Guidelines for implementation and the International Plans of Action that were developed and adopted in its framework, the Code is now widely recognized by governments and NGOs as the global standard for setting out the aims of sustainable fisheries and aquaculture over coming decades and as a basis for reviewing and revising national fisheries legislation. In adopting the Code, FAO member countries requested the Organization to respond to the special requirements of developing countries through an Interregional Assistance Programme for its implementation. FishCode was thus established by the FAO Fisheries Department as a special programme of global partnerships to promote responsible fisheries.

information on spearfishing management, those replies and any documentation obtained were simply summarized in tabular form (Appendix 1).

The taxonomy of some of the species important for spearfishing is not simple. During the short country visits, some of the speared fish species discussed were not actually sighted and discussions of these fish often used local names. A local name sometimes corresponds to a number of species and, conversely, some species have several local names, often depending on fish size. In addition, some of the common spearfishing species are very difficult to identify.[3] For these reasons and time limitations, this report uses simplified taxonomy in which, if there is any doubt, higher-level taxa are used. For example, when it could not be easily determined if a particular parrotfish belongs to one of several genera, the family name Scaridae has been used. In this report, unless otherwise specified, species composition is by weight.

There is some difficulty in classifying spearfishing itself. In the Pacific islands a wide variety of spears are used for catching fish, including poles, slings, harpoons, barbs, and guns. Some of this gear is used in very specialized fisheries, such as dolphinfish harpooning in French Polynesia, shrimp spearing in Fiji, and the use of weighted beche-de-mer spears in Ontong Java, Solomon Islands. Because this report is concerned on the type of spearfishing that is of large and increasing importance in the management of Pacific Island inshore fisheries, it focusses mainly on underwater spearfishing and excludes spearing from boats and while wading. Unless otherwise specified, "spearfishing" in this report refers to underwater spearfishing.

The short country visits made during the field study were of necessity restricted to some degree to urban and peri-urban areas. Efforts were made, however, to obtain information from non-urban areas. This included additional work in a remote location of Fiji, contacting individuals familiar with rural spearfishing in all countries visited, and inclusion of some spearfishing data from another SPC project that focussed on rural areas (Section 4.0). Although such efforts were made, it is likely that some geographic bias remains.

2. Information on spearfishing from country visits

Aspects of spearfishing were examined during short visits in late 2005 to five countries: Fiji, Tonga, Samoa, Tuvalu, and the Solomon Islands. In each country, information was collected on:

- types of information available on spearfishing in the country;
- general structure of the spear fishery;
- species captured;
- information on the significance of spearfishing relative to other sources of fishing mortality;
- regulatory and policy measures relevant to spearfishing;
- important issues related to spearfishing; and
- observations and comments on spearfishing and its management.

Fiji received more coverage than the other countries due to two factors. A USP student was contracted to collect information on an opportunistic basis over a two-month period while surveying reef areas in rural areas of Fiji's second largest island, Vanua Levu. In addition, the consultant recruited for this study is based in Fiji and was able to make observations over a longer period of time than in the other countries.

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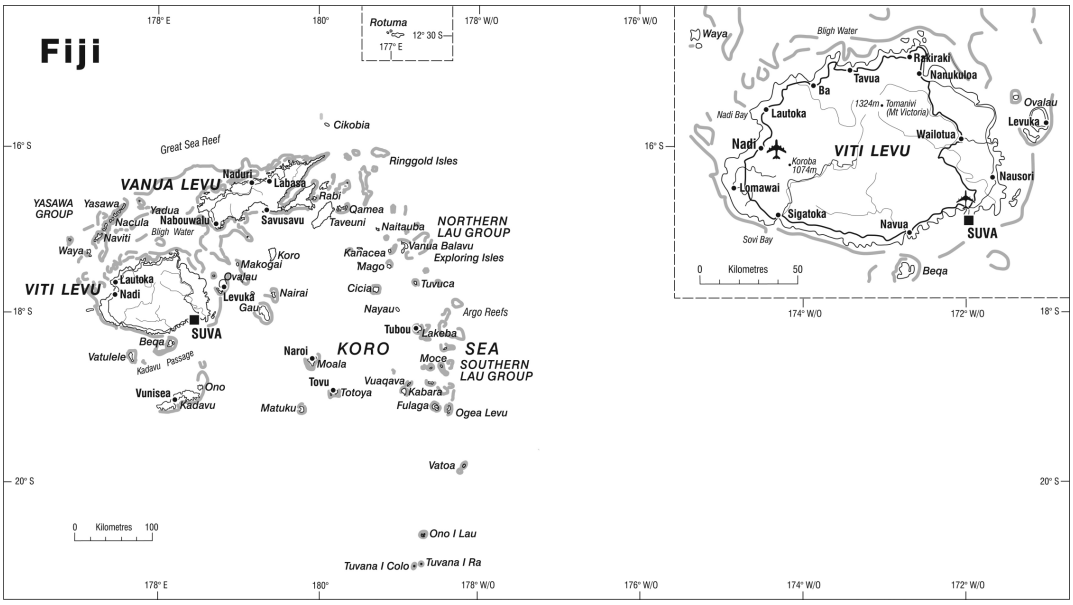
[3] For example, Carpenter and Niem (1998) state: "Parrotfishes are difficult to identify. There are few morphological features or meristic values that enable even genera to be separated. At the species level, meristic values are rarely diagnostic. Most identifications therefore must rely on colour patterns. However, most species have at least three distinct patterns throughout life. The colours also change after death. Many species share common colour patterns. The western and central Pacific area also contains a lot of geographic variants or species pairs which overlap, particularly in the western part of the area."

2.1 Information on spearfishing in Fiji



2.1.1 Types of information available on spearfishing

The Fiji Fisheries Department has a system for collecting statistics on the inshore artisanal fishery which dates from 1977. A crude scheme for estimating production in the inshore subsistence fishery was formulated in 1978. The main outputs of these systems have been:

- For the artisanal fisheries, estimates are made of amounts and values of finfish and non-finfish at the municipal markets and some outlets on the two main islands; and
- For the subsistence fisheries, for each year over the past 26 years, estimates are made simply by adding 200 tonnes to a crude 1978 production figure.

The Fisheries Department also maintains a database of fish exports (unverified) and a database of exports covered by CITES. Because these statistical systems do not collect information by gear type, not much can be inferred about spearfishing. Although it is conceivable that some information could be obtained from the statistical system by production trends in species that are exclusively captured by spearfishing, important trends could be masked and/or distorted by factors such as changes spearfishing areas or number of divers.

One-time "snapshot" surveys offer some information on spearfishing in Fiji. The most notable survey of this type is "Survey of the Subsistence and Artisanal Fisheries in Rural Areas of Viti Levu, Fiji" (Rawlinson *et al*. 1994), which contains information about the importance of spearfishing relative to other gear and ownership of spearfishing and other gear.

Many reports give some indication of spearfishing at specific locations in Fiji. These cover such areas as northeast Macuatu (Nandlal *et al*. 2002), Sasa Village, Vanua Levu (Fong 1994), Ono-I-Lau (Kuster *et al*. 2003), Vanuabalavu (Sesewa, 1984), and Kaba Peninsula (Van der Meeren 1996). Most of these accounts are limited to descriptions of fishing gear and fishing methods, and little is provided on such topics as problems associated with spearfishing or considerations of mitigation measures. Dulvy and Polunin (2004) give information on the decline in the Lau Group of the humphead parrotfish, mainly due to spearfishing. The World Bank 1998 comparative study of coastal resource management included six coastal villages in Fiji, and contained information on perceived threats to coastal resources, including those associated with spearfishing.

Much of the information in this section on spearfishing in Fiji is from discussions in October and November 2005 with knowledgeable individuals. These included seven fisheries officers, eight spearfishers based in Nabukalau Creek, one retired diver, five fish vendors in Nabukalau creek, one Vatuwaqa fish vendor, one owner of retail fish market, four staff from the University of the South Pacific, two resort managers, representatives of two environmental NGOs, three dive shop operators, a supervising doctor at the recompression chamber, six other individuals very familiar with the Fiji fishing industry, one external fish spawning aggregation specialist, one reef ecology advisor to Fiji resorts, and one aquarium fish business manager. In addition, a USP student was contracted to obtain spearfishing information in September and October 2005 on an opportunistic basis in the Kubulau area of southwest Vanua Levu Island (to the east of Savusavu on the Fiji map above). Twelve spearfishers, the village headman, Fisheries Department staff in Savusavu, and a fish vendor were interviewed by the student.

2.1.2 General structure of the spear fishery in Fiji

Although the use of spears in fishing in Fiji is a traditional activity (e.g. for catching mullet in shallow water while wading), the widespread use of spears underwater, especially the use of spearguns, is a fairly recent activity. Hornell (1940) indicates that underwater spearfishing was popularized by the introduction of diving goggles ("submarines" or "suvamarini") from Japan in the 1920s. Other historical developments related to spearfishing include:

- underwater battery-powered torches in the 1960s and 1970s, which facilitated night diving;
- the introduction of scuba gear for spearfishing in the early 1980s;
- the expansion of the range of suva-based divers in the early 1990s to areas beyond viti levu and the islands in beqa lagoon;
- a greater number of individuals and boats participating in commercial spearfishing over the last five years; and
- some tendency recently for beche-de-mer divers to switch to spearfishing.

There are two main types of spearfishing in Fiji: (a) the urban-based operations harvesting fish for sale; and (b) village-based mainly subsistence diving. Other types of spearfishing include occasional spearing by beche-de-mer divers, and recreational spearfishing by both local residents and tourists. In addition, a former tuna fishing vessel, the *Wellbeing No.3,*[4] has been recently licensed by the Fisheries Department for spearfishing in conjunction with villages.

2.1.3 Urban-based commercial spearfishing

Commercial spearfishing operations are based in and around most of Fiji's larger cities. Discussion with divers in Suva indicate there are diving groups based in Nabukalau Creek (central Suva, about 15 fibreglass vessels) and in the suburbs at Vatuwaqa (about 4 boats), Laqere (5 boats), and Navua (2 boats).[5] All of these vessels are outboard powered fibreglass skiffs (Figure 1).

[4] The *Wellbeing No.3* carries 15 divers (mainly from Kadavu Island) and on a recent two-week spearfishing trip to the islands to the east of Vanua Levu, returned to Suva with 16 tonnes of fish.

[5] Participants in the aquarium fish industry indicate several more spearfishing boats are based in the Navua area. In addition to vessel at these four locations, others may occasionally participate in spearfishing.

Figure 1: A spearfishing vessel at Nabukalau Creek, Central Suva

Because Nabukalau Creek has the largest number of spearfishing vessels and divers, special attention was focussed on that area. A typical spearfishing trip from Nabukalau involves three to six men, departure in the late afternoon, and return just after dawn the following day. Some vessels are also active during the day, which usually involves the use of two crew (rather than a crew choosing daytime operations over the characteristically better fishing at night).

Spearfishing appears to be largely an activity of indigenous Fijians. Almost all divers at Nabukalau are Fijians, whereas gillnetting is dominated by Indians.

Most divers do not own the vessels they use. The usual situation is that a businessman (at least one is an ex-diver) or a fish vendor will own one or more vessels and have some financial arrangement for the divers to use it. If the owner is a vendor, this would also involve the sale of fish to that vendor. Several people in Nabukalau Creek indicated that "almost all" the fibreglass skiffs presently involved in spearfishing were originally obtained through a subsidy scheme of the Fisheries Department.[6]

While diving and spearing, each diver retains his own catch, which he organizes into "bundles" of about 3 kg before sale. A Suva fish retailer with considerable experience in buying fish from Nabukalau indicates that a typical spearfishing boat catch would be 40 to 100 bundles per night of diving. Prices paid to the divers are variable, but a few fish receive a premium price: the humphead wrasse (*Cheilinus undulates*), certain rockcods (*Cephalopholis* spp.), and some emperors (*Lethrinus* spp.). Tiko's floating restaurant (anchored off the central Suva waterfront) also pays a premium for certain species, which change according to the restaurant's requirements. In October 2005 Tiko's was paying F$16 per kg for lobster.

Considering the small size of the boats involved in Suva-based commercial spearfishing, the range covered by these vessels is surprisingly large. According to Nabukalau divers, they occasionally visit the islands of Vatulele, Kadavu, Beqa, Moala, Gau, Nairai, Wakaya,

[6] The 2003 Fisheries Department Annual Report states: "31 identified small-scale tuna fishers were assisted through providing fishing gears, safe affordable and recommended outboard engines and punts, under the small-scale subsidy scheme of a total sum of $332,999."

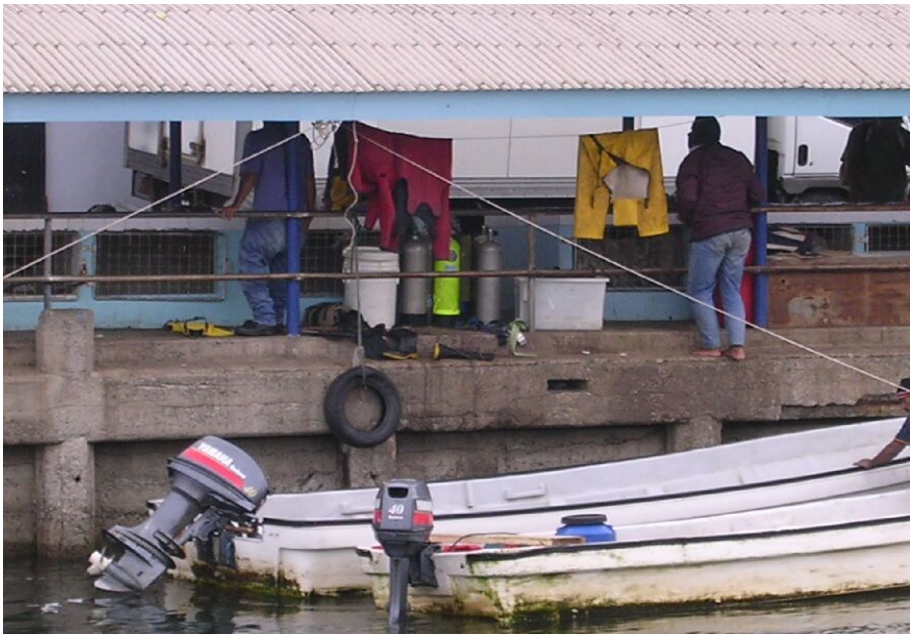
Makogai, and Namena, in additional to the closer diving grounds off the coast of Viti Levu. The reason most often given for the long trips is depletion of fish resources in areas close to Suva.

The fishing gear is quite basic. All divers have fins, masks, and snorkel and most divers (in October 2005) have some sort of wet suit. The type of spear gun used is dictated by the time of operation: long guns for stalking fish during the day, short guns for "easy killing of sleeping fish" at night. Most of the skiffs have 60 horsepower outboard engines, quite large relative to the boat size.

Scuba gear is regularly used by several Nabukalau-based spearfishers. Because it is illegal in Fiji without special permission to use scuba to "collect, take, or dive for fish",[7] information on the use of scuba for spearfishing is not easily acquired in discussions with divers. Nevertheless, over a ten-day period at Nabukalau Creek in late October 2005 the following was obtained:

- During the first two days of discussions and picture taking at Nabukalau, most of the skiffs arriving back from a fishing trip had scuba tanks aboard. During the last two days of discussion only one skiff was observed carrying tanks.
- Scuba use is apparently more prevalent in areas close to Suva and during daytime diving, presumably because the great difficultly in obtaining commercial quantities of fish by free diving in those areas during the day.
- The divers who do not use scuba mostly cite the reason of "fear of getting diving sickness" rather than the fact that using scuba is illegal. None of the divers or vendors interviewed was aware of any efforts in recent years by the Fisheries Department at Nabukalau to reduce the use of scuba in spearfishing. The casual manner in which scuba tanks are stored at Nabukalau (Figure 2) supports this contention.

Figure 2: Scuba tanks at Nabukalau Creek



[7] Fisheries (Registration and use of underwater breathing apparatus) Regulations, 1997 – Legal Notice No.17 of 1997.

2.1.4 Rural spearfishing

As a case study, information on rural spearfishing in Fiji was obtained on an opportunistic basis in the Kubulau area of southwest Vanua Levu Island during a six-week period from August to October 2005.

Spearfishing is a very popular fishing technique in Kubulau, responsible for about 50 percent of the fish caught in the eleven communities adjacent to the Kubulau traditional fishing area. Other methods include line fishing, gillnetting, and trolling. Most able-bodied men often go spearfishing, with women doing most of the line fishing.

The important spearing areas are about 3 to 6 km away from the villages, although spearfishers sometimes go to sites up to 20 km away depending on the weather. Outer barrier reefs are normally associated with rougher seas so inner reef areas are subjected to more fishing pressure.

Fish caught by spearing is mainly for family use, but is occasionally sold when a villager goes to the market at Savusavu town (an hour away by fast boat; three hours away by truck) or when a travelling fish buyer visits the area. The unavailability of reliable refrigeration facilities or ice due to intermittent electricity provided by village generators creates difficulties for commercial fish sales. However in one village, Navatu, 70 to 80 percent of the fish caught by spearing is sold to an agent who lives in the village and makes regular trips by boat to the market in Savusavu.

The most common form of spear equipment in Kubulau is a medium-size Australian-made spear gun, although a sharpened steel rod with rubber sling known as "Kilivati"[8] is also common. Most divers use spear guns along with wetsuits, masks, snorkels, dive torches, weights and blue plastic drums cut in half (Figure 3). These are attached to divers by a long rope and serve as storage for the catch while diving.

Figure 3: A spearfisher in the Kubulau area of Southwest Vanua Levu

Because spearfishing gear is relatively expensive in Kubulau, it is often financed by fellow villagers who work in distant urban centres. Expendable items (batteries for dive torches and

[8] From the word "Gilbertese", the people that introduced the gear into Fiji.

spare parts for guns) are easily accessible in Savusavu. At least some of the gear (and habit of using the gear) came from the beche-de-mer diving boom in the early 1990s, when gear was given to villages by buyers to encourage the gathering of beche-de-mer.

Fishing trips to outer reefs are often conducted in groups of six to eight people, including a boat driver. Some spearfishing is also done from the shore diving individually. All boats used are wooden and powered by 15 or 25 horsepower outboard engines.

Night diving is preferred by the divers as it is more productive and because of the relative ease of shooting sleeping species. Daytime diving is common, mainly for subsistence use and for those who have limited opportunity to use a boat.

Another form of spearfishing practised in the Kubulau area is a modified version of the traditional hand spearing "tukidodo" which is made using a thin straight bamboo shoot of about two metres in length and lashing on about eight to ten thin sharpened metal spokes or prongs to the end. This is used while wading in shallow water over reef tops or along the shoreline on the receding tide, targeting mullets, emperors and garfish. The technique is very common with the younger boys in the village who often carry two of these spears. They are quite skilled, as evidenced by good catches, sometimes even returning with barracudas and carangids.

With respect to scuba use in spearfishing, outside commercial operators were given permission by Kubulau traditional authorities about five years ago to harvest only beche-de-mer using scuba gear. They did, however, use scuba gear for at least some spearfishing and consequently the permission to harvest beche-de-mer was recently terminated.

2.1.5 Target species

As mentioned in Section 2.1.1 above, the statistical system of the Fisheries Department does not collect information by gear type, and therefore not much can be inferred from the system about the species taken by spearfishing. During the short period of the present study it was not possible to institute a catch sampling programme to determine species composition. The following information is therefore from qualitative observations and from discussions with divers and fish vendors.

The divers based at Nambukalau Creek indicate that anything encountered while diving which has economic value is a target. The men say that they will shoot or take "anything that moves". The catch composition largely reflects the fish that are vulnerable to spearing, rather than any preference of the diver. If there is any choice, the diver will obviously shoot at large individuals of high value species, but, according to divers, they do not often have to make this decision. It appears that no fish are actively avoided, including under-size fish.[9]

There appears to be at least some exceptions to the above. One advantage of scuba gear is the ability to dive deeper, in which case several divers expressed the opinion that those divers may target certain high value species, like the humphead wrasse (*Cheilinus undulatus*). Aside from scuba use, Dulvy and Polunin (2004) give information on the decline in the Lau Group of the humphead parrotfish, mainly due to spearfishers targeting this fish.

The displayed fish of several Nabukalau Creek vendors were examined over a ten-day period at the end of October 2005. At a general level, it was concluded that:

- The vast majority of fish offered for sale are from spearfishing. Line fishing and net fishing produce much smaller amounts, probably less than 20 percent combined.

[9] The Fisheries Regulation 18 specifies minimum sizes for 20 types of fish.

- The species composition of the speared fish is greatly affected by area of fishing (Suva reefs vs. distant islands) and time of fishing (day vs. night), and to a lesser degree by gear used (scuba vs. free diving).

Large parrotfish (Scaridae) and large unicornfish (*Naso* spp.) dominate the catches sold in Suva that originate from distant islands. Minor components include squirrelfish (Holocentridae), rabbitfish (*Siganus* spp.), surgeonfish (*Acanthurus* spp., mainly large individuals), groupers (Serranidae, mainly small individuals, but occasionally some large fish), emperors (*Lenthrinus* spp.), and the red bass (*Lutjanus bohar).*

A large number of species, generally of small size, are characteristic of spearfishing catches of reefs near Suva. Parrotfish (Scaridae) are a major component, along with goatfish (Mullidae) and surgeonfish (*Acanthurus* spp.). Many other species are present, but the most common during late October 2005 appear to be small groupers (Seranidae), squirrelfish (Holocentridae), rabbitfish (*Siganus* spp.), and emperors (*Lenthrinus* spp.). Non-finfish are also taken. Most vessels returning from diving trips had small quantities of lobster (speared) and beche-de-mer. During the day while waiting for darkness, some divers search for trochus, rather than spearfish.

It should be noted that what is displayed for sale at Nabukalau may be somewhat different from the fish actually captured. This could be due to restaurant and other sales before landing the catch at Nabukalau, keeping some fish in ice box for later sale, and fish taken for the diver's own consumption. According to Nabukalau fish vendors, several species of fish are never caught by spearfishing, including tuna, mullet,[10] and garfish.

Information was also collected on spearfishing catch composition from the rural case study in the Kubulau area of southwest Vanua Levu Island (Section 2.1.4 above). Spearfishers in that area know well the three grades of fish[11] and appear to have a tendency to target the higher value species. Nighttime divers appear to be somewhat more selective for large fish and non-fin fish (lobster, crabs). Unicornfish, parrotfish, surgeonfish and groupers make up the majority of the combined day/night catch. Surgeonfish appears to be more prevalent during daytime catches, along with squirrelfish, goatfish, moray eels and emperors. When scuba is used, the catch has a higher proportion of groupers, barracuda, carangids and Spanish mackerel.

2.1.6 Significance of spearfishing relative to other sources of fishing mortality

As given in the section above, the main species captured by Suva-based spear fishers in October 2005 appear to be parrotfish, unicornfish, surgeonfish, and goatfish. In the areas where spearfishing occurs, the other fishing methods consist mainly of gillnetting and line fishing. Using information from a former fisheries officer (R. Stone, pers. comm.) and two Nabukalau fish vendors, some speculation can be made on the relative importance of the various source of fishing mortality on the main spearfishing species.
This is summarized in Table 1.

[10] The vendors were apparently referring to Nabukalau-based spearfishers – mullet is often speared during wading in other parts of Fiji.
[11] Grade A fish – F$3.00/kg; Grade B fish – F$2.50/kg; Grade C fish – F$2.00/kg

Table 1: The main spearfishing species and associated sources of fishing mortality

	Spearfishing (%)	Gillnetting (%)	Line fishing (%)
Parrotfish	**70**	**30**	**Only rarely**
Unicornfish	**70**	**30**	**0**
Surgeonfish	**60**	**30**	**0**
Goatfish	**60**	**40**	**0**

The information in the table should be considered indicative at best. The fish vendors may be unaware of catches of those species which do not pass through the markets where they are located.

2.1.7 Regulatory and policy measures relevant to spearfishing

The Fisheries Act gives special status to "spearing":

- Although commercial fishing in Fiji requires a licence, the Act exempts spearing from this requirement: "No person shall take fish in Fiji fisheries waters by way of trade or business or as an employee of a person carrying on the trade or business of a fisherman unless such person is authorized by a licence to take fish: Provided that……a person who takes fish with a line from the shore or with a spear shall not be required to obtain such a licence".
- Although fishing in another group's traditional fishing rights area requires approval, the Act exempts spearing from this process: "It shall be an offence for any person to take fish on any reef or on any kai (cockle) or other shellfish bed in any area in respect of which the rights of any mataqali or other division or subdivision of the Fijian people have been registered by the Native Fisheries Commission in the Register of Native Customary Fishing Rights unless he shall be a member of such mataqali, division or subdivision of the Fijian people who does not require a licence under section 5 to take such fish or shall first have obtained a permit to do so from the Commissioner of the Division in which such area is situated: Provided that-- (a) such permits shall not be necessary in the case of persons taking fish (other than by way of trade or business or as the employee of a person carrying on the trade or business of a fisherman) with hook and line or with a spear or portable fish trap which can be handled by one person." [underlining added for emphasis]

Although the intent of the Act was apparently to give special protection to traditional Fijian spearing, it also unintentionally exempts fishing using modern mechanical spearguns.

Other legislation applicable to spearfishing includes:

- Fisheries (Restrictions on Use of Breathing (Apparatus) Regulations, 1997 ban the use of underwater breathing apparatus to "collect, take, or dive for fish", but allow the Permanent Secretary or any person appointed by him in writing, to exempt a person from this requirement.
- The Sixth Schedule of the Fisheries Regulation establishes minimum sizes for 21 types of fish, including many that are often caught by spearfishing.

In mid-2004 a notice appeared in the Fiji Times indicating a ban on the commercial take, capture for sale, offer for sale, or possession of live or dead specimens of the humphead wrasse (*Cheilinus undulatus*). The notice stated that "the ban is to take place on 30 September 2004 and expires on 31 December 2014" and that "the Fisheries Act 2004 (sic) will be amended accordingly to effectively carry out this ban". According to officials of the Fisheries Department, the regulation was gazetted on August 31, 2004 as Legal Notice No.78. This regulation is apparently not well enforced; vessels arrive at Nabukalau in the middle of Suva in the middle of the day with this species in full view of the public (Figure 4).

Figure 4: A humphead wrasse aboard a vessel offloading fish at Nabukalau

With respect to traditional fisheries rules affecting spearfishing, most of the 410 traditional fishing areas have their own local fishing rules and many of those are applicable to spearfishing. Examples of these rules (from World Bank 2000) are a ban on night diving (Nakawaga Village), a ban on the use of diving compressors (Vunivutu Village), and a ban on the use of scuba for fishing (Ucunivanua Village). The latter is an example of what World Bank (1990) referred to as "best of both worlds"; national rules that have been adopted as local rules are perceived by residents as achieving greater compliance than either purely local or purely national rules.

Local bans on the use of gillnets and scuba diving equipment for spearing fish are two of four prohibitions or "chiefly bans" which have been in place since 1989 in the combined traditional fishing areas of the districts of Dreketi, Macuata, Sasa and Mali (Fong, 1994). Dulvy and Polunin (2004) report a ban on nighttime spear fishing ban at Fulaga Island in the Lau Group.

The Nabukalau-based spearfishers interviewed indicated that they generally had no fear of being apprehended while fishing unauthorized in the various traditional fishing grounds. They felt that it was quite difficult to be detected, but if so, few villagers had the resources or inclination to chase down the intruding divers and get involved in any subsequent punishment. It is interesting to note that two spearfishers independently stated that the exception to this was at Astrolabe Reef off Kadavu Island. At that location the chance of being detected is far greater and the villagers are "too good at chasing and catching divers". This situation is further explored in Section 2.1.9.

Information was also collected on spearfishing regulation compliance from the rural case study in the Kubulau area of southwest Vanua Levu Island (Section 2.1.4 above). At Kubulau there seemed to be little or no awareness of any government regulations affecting spearfishing, with fishers shooting undersized fish and some using scuba. It is interesting to note that the feeling amongst the villagers that using scuba is bad seems to be from social pressure to avoid what is considered an unsustainable practice, rather than because of any government regulation.

2.1.8 Important issues related to spearfishing in Fiji

Some of the important issues related to spearfishing are:

- commercial spearfisheries depleting fishery resources in areas which may be quite important for village food supplies;

- the low priority given to enforcing legislation related to spearfishing (the ban on the use of scuba for fishing, the minimum size limits for many of the speared species, and selling of a protected species);
- the exclusion of "spearing" from commercial fishing activities that require a licence, and the exclusion of "spearing" by outsiders from activities that can be regulated by traditional authorities under the Fisheries Act;
- the difficulty of collecting evidence required for a successful prosecution of fishing with scuba gear;
- the difficulty of villagers enforcing their rules on fisheries activities that mainly occur at night;
- the question of the compatibility of marine-oriented tourism and spearfishing, or at least commercial spearfishing;
- the health risks of scuba to untrained divers;
- the use of large "fish collection vessels" in conjunction with spearfishing (do they assist in village development projects or are they more of a case of industrial-scale fishing operations using cheap village labour to target and deplete fairly fragile fishery resources?); and
- the targeting of fish spawning aggregation by spearfishers.

2.1.9 Some observations and comments on spearfishing and management in Fiji

Over the past century there have been a number of changes in the Fiji spearfishing that altered its economics: the introduction of diving goggles, diving torches, and scuba gear, and the Fisheries Department providing subsidies for acquiring vessels/outboards. Each of these allows spearfishing to be economic at progressively lower levels fish abundance. In many other fisheries, lowered catch rates usually cause fishers to switch target species or locations before the resource population nears local extinction, but this may not be the case for spearfishing. Night spearfishing and scuba spearfishing may be able to continue even after the fish abundance in an area is too low to sustain a viable reproductive population.

In Fiji's present political situation, there is considerable difficulty in placing controls on the economic activities of indigenous Fijians. In fact, both divers and some Fisheries Department officials indicate that this justifies the non-enforcement of legislation relevant to spearfishing. This concept, however, does not appear to be entirely consistent – those indigenous Fijians living in villages adjacent to areas in which the fish resources have been depleted by unregulated spearfishing (who are typically far less affluent than the urban-based commercial spearfishers) may carry the burden of the lax enforcement.

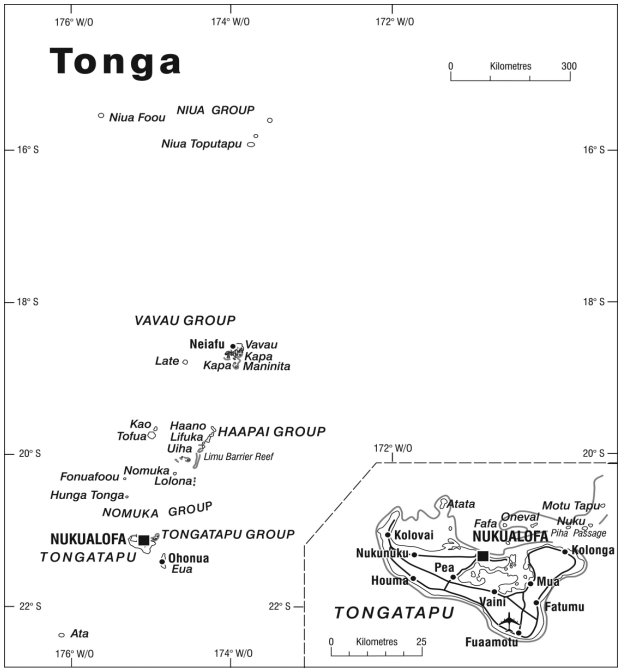
Some thought should be given to the strategy for improving enforcement of fisheries legislation dealing with spearfishing. The reaction of one fisheries officer when shown the under-sized fish offered for sale at Nabukalau was to immediately confiscate the whole lot. On reflection, this may not be the best course of action. The long period of inactivity of the Fisheries Department in enforcing size limits and other restrictions has in itself engendered a feeling that compliance is not important, even among the most conscientious divers and vendors. Accordingly, there appears to be a case for an initial "tightening up" period in which the intention substantially to improve enforcement is made known to the fishers and fish vendors though such activities as verbal warnings, signs, and newspaper articles. Because the fish vendors and vessel owners exert some degree of control over the geographically diverse activities of the divers, the vendors/owners should feature prominently in efforts to improve enforcement – vessel confiscations and hefty penalties on vendors for under-sized catches could be more efficient than attempts at enforcement on thousands of square kilometres of fishing grounds.

In Section 2.1.7 above, it was noted that the traditional owners of Astrolabe Reef seem to be doing a better job of preventing poaching by Suva-based spearfishers than the owners of other fishing areas. Because it may have implications for the management of spearfisheries in general, this issue was followed up with officials of the University of the South Pacific

(which has a research station at Dravuni village near Astrolabe) and with Astrolabe Incorporated (a USA-based NGO). Although the situation is not clear and may warrant further investigation, the increased diligence of the Dravuni villagers could be due to a number of factors. These include sensitisation of the villagers by outside partners (USP, Astrolabe Inc.) as to the value of their coastal resources and the harm done to the resources by poachers. It also seems that a single individual, Radike Qereqeretabua, who originates from Dravuni and is well known around Fiji, may have had much to do with inspiring the villagers to take action. The diligence of the Dravuni villagers is apparently not due to the government and outside agencies supplying boats and petrol for surveillance, as has occasionally been suggested for Fijian traditional fishing areas in general.

From the rural case study, it is evident from community meetings that the major spearfishing concerns at the village level in southwest Vanua Levu are the use of scuba and the increasing popularity of night diving. The communities are well aware of that the impacts of such practices, although highly productive and profitable for the present, cannot be sustained in the long term.

2.2 Information on spearfishing in Tonga



2.2.1 Types of information that are available on spearfishing in Tonga

There are several sources of information on spearfishing in Tonga. *Fishermen of Tonga* (Halapua 1982) contains a chapter on spearfishing at Tongatapu in the mid-1970s. The FFA Tonga Fisheries Resource Profiles (Bell *et al*. 1994) cite studies in the late 1980s that show the species composition of spearfishing catches. The Japan International Cooperation Agency (JICA) supported an inshore fisheries statistics system at the Ministry of Fisheries from the early 1990s through 1998. Some of these JICA reports up to 1997 are presently available at the Ministry. The World Bank's 1998 comparative study of coastal resource management (World Bank 2000) included six coastal villages in Tonga, and contained information on perceived threats to coastal resources, including those associated with spearfishing. SPC's Reef Fisheries Observatory carried out fieldwork in Tonga and other countries and collected a large amount of data, including information on spearfishing. AusAID Tonga Fisheries Project staff collected information (including catch composition by gear type) of fish transported to Tongatapu from the island groups in the north of Tonga.

Much of the information in this section on spearfishing in Tonga is from discussions in November 2005 with knowledgeable individuals. These included eight fisheries officers, four spearfishers based in Tongatapu's Faua Harbour, one official of the AusAID Tonga Fisheries Project, two fish market managers, one dive shop manager, two resort operators, one resident of a village on the east coast of Tongatapu, and several individuals knowledgeable on Tonga fisheries, including those with experience in Vava'u and Ha'apai.

2.2.2 General structure of the spear fishery in Tonga

The use of underwater torches appears to have originated in the 1960s. Halapua (1982) indicates that spearfishing in Tongatapu (both day and night) was well-established in the 1970s with 57 full-time divers. He also states that most Tongatapu divers at that time had Ha'apai origins. A beche-de-mer boom in Tonga (roughly mid-1980s to mid-1990s) and its associated diving with hookah[12] and scuba apparently increased the skills and interest of individuals in this gear, while a beche-de-mer ban in the mid-1990s created a pool of unemployed divers. Every few years in recent decades there have been schemes in which large vessels have been used to transport divers to distant reefs for spearfishing. This has often involved Minerva Reef and tuna fishing vessels. The most recent development to affect spearfishing in Tonga is a large increase in the price of outboard fuel, which has implications for both areas fished and profitability.

Halapua (1982) recognized three types of spearfishing in Tongatapu: night spearing, deep-water day spearing, and shallow-water day spearing. At present, there does not appear to be a sharp distinction between the types of day spearing. Knowledgeable individuals indicate several types of spearfishing in Tonga: predominantly subsistence, small-scale commercial, recreational, and operations that involve many divers on a large vessel.

The gear used is not very sophisticated. Fins, masks, and snorkel (often very worn) appear to be used be all divers. Sling spears are far more common than spearguns. Wetsuits are not often used. The Tongatapu spearfishing vessels are all outboard-powered and most are made of wood and have a small cabin (Figure 5).

Figure 5: A Spearfishing boat based at Faua Harbour, Tongatapu

[12] Hookah – a colloquial, but widely used, term for a surface supply diving apparatus usually involving the supply of breathing air from a small compressor unit via a free floating air supply hose to a mouth held demand breathing gas supply device. For simplicity, in this report unless otherwise stated, the term "scuba" includes "hookah".

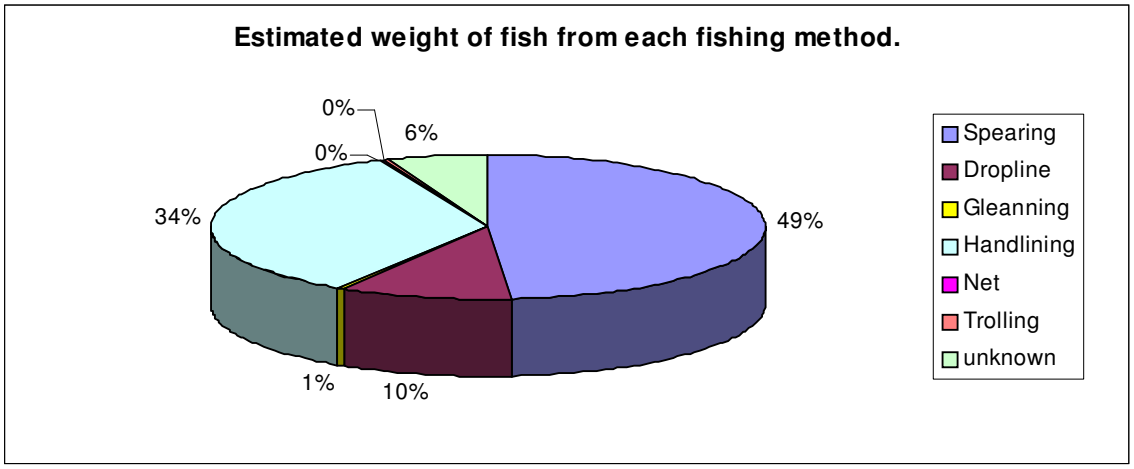
During the short survey period, scuba gear was not observed on any of the spearfishing vessels. However, several spearfishers and some of the more knowledgeable fisheries officers indicate that scuba is used by some spearfishers. One person offered the opinion that scuba use is more prevalent on those boats that operate out of coastal villages, rather than those from Faua Harbour. That person also stated that the presence of large unicorn fish in a spearfishing catch is an indicator of the use of scuba.

According to individuals based in Tonga's Vava'u and Ha'apai Island groups, spearfishing in those areas is not markedly different from that in Tongatapu. The major differences are that in Ha'apai, a larger proportion of people participate in spearfishing and that the economics of commercial spearfishing largely revolve around the export of fish to markets in Tongatapu. Vava'u exports less fish to Tongatapu, while an important commercial aspect is the sale of lobster (caught by diving, mostly speared) to tourist-oriented hotels and restaurants in Vava'u.

The JICA-supported inshore fisheries statistics system gives considerable information on spearfishing in Tongatapu in the 1990s. The latest report that is readily available (Vaikona *et al*. 1997) covers the year 1996. Of the 77.7 tonnes of fish sampled at two sites in Nuku'alofa, 39.5 tonnes came from night diving while 6.5 tonnes came from day diving. The combined amount for night and day diving represented 59 percent of the total landings at the two sampled sites.

A recent survey (Lautaha and Cohen, 2004) showed that in one month about 16.5 tonnes of fish were transported by ferry to Tongatapu from the islands of Ha'apai (68% of the total) and Vava'u (32%). Almost half of the fish that arrived on the ferries was caught by diving, 34% from handlining, and around 10% from droplining. The rest was caught using various other methods, including netting and gleaning. This information is depicted in Figure 6.

Figure 6: Methods used to capture fish arriving by ferry from Vava'u and Ha'apai



Source: Lautaha and Cohen (2004)

According to knowledgeable individuals, most of the Tongatapu commercial spearfish catch is sold at Vuna Harbour and to a lesser extent in the coastal villages where some of the spearfishers are based. Lautaha and Cohen (2004) state that about half the fish that is transported to Tongatapu by ferries from the outer islands goes to the Tuimatamoana market, with fish going to private companies and fish for personal consumption accounting for 23% and 15%, respectively.

Kronen (2004) studied socio-economic aspects of Tonga's artisanal fisheries, including spearfishing. She concluded that much spearfishing is comparatively low in productivity and is unlikely to achieve economic viability. The imbalance between revenue and cost does not

change if lobsters, a comparatively high value product, are added to the usual finfish catch. Why then do spearfishers continue to fish? Kronen argues that Tongan artisanal fisheries are largely oriented to Tongan values (satisfy subsistence requirements, contribute to social obligations, the desirability of fishing as a lifestyle) rather than a profit-seeking private enterprise that gives priority to catch maximization and risk minimization.

2.2.3 Target species

The spearfishers interviewed indicate that they will attempt to capture anything of economic value they encounter while diving. All fish and many invertebrates are "targets".

Quantitative information on the species composition in the Tongatapu spearfishing catch[13] is given in Vaikona *et al*. (1997). They give the five major species caught by six fishing techniques, including night diving and day diving (Table 2).

Table 2: The five major species caught by diving

	Tongan name	**English name**	**Percentage in catch category**
Night diving	Hohomo	Parrotfish *Scarus* spp.	19%
	'Ume	Unicornfish *Naso unicornis*	17%
	Ma'ava	Rabbitfish *Siganus argenteus*	17%
	Olomea	Parrotfish *Scarus* spp.	10%
	Pone	Surgeonfish *Acanthurus* spp.	7%
	Others		30%
			100%
Day diving	Pone	Surgeonfish *Acanthurus* spp.	38%
	Hohomo	Parrotfish *Scarus* spp.	13%
	Feke	Octopus	9%
	Ngatala	Grouper *Epinephelus* spp.	8%
	Ta'a	Squirrelfish *Ostichthys* spp.	5%
	Others		26%
			100%

Note: English/scientific names from Bell *et al.* (1994)

A survey in the 1980s cited in Bell *et al*. (1994) gave the 18 most important Tongatapu inshore species and the gear used to capture those fish. Of those 18 species, the most important for spearfishing[14] were three species of emperors: *Lethrinus nebulosus, Lethrinus elongatus, and Lethrinus ramak.*

[13] Many of the surveys in Tonga consider the fishing method to be "diving", which is somewhat different than "spearfishing".

[14] This is not the same as stating that the three species are the most important component of the spearfishing catch.

The species composition of the present-day spearfishing catch, as inferred from observing the catch at Vuna Harbour and discussions with fisheries officers in November 2005, appears to be closer to that of Table 2 above, rather than that suggested by the 1980s survey.

During the short study period in early November 2005, giant clams and octopus were a large component of the daytime diving catch. Fuka (1979) noted that due to the time and effort needed to prepare the traditional lure (makafeke), fishers have abandoned this technique and are turning to spear guns and skin diving equipment as the more popular method for octopus fishing.

Figure 7: A Tongan spearfisherman with sling spear and catch of unicornfish

2.2.4 Significance of spearfishing relative to other sources of fishing mortality

Information from Vaikona *et al*. (1997) and Bell *et al*. (1994) was used to construct Table 3.

Table 3 shows that diving is responsible for almost all of the fishing mortality on six out of the eight species (or species groups) commonly caught while diving. Information from fisheries officers and knowledgeable individuals is somewhat different. They indicate that only about 60 to 80 percent of all parrotfish landings are from spearfishing and that significant quantities of unicornfish are captured by nets.

Table 3: Annual sampling in 1996

Tongan name	English/scientific name	Fence	Hand line	Net	Night dive	Day dive	Troll	Total	Day/night diving catch as % of total catch
Hohomo	Parrotfish *Scarus* spp.	0	55	36	3 703	598	0	4 392	97.9
‘Ume	Unicornfish *Naso unicornis*	0	21	0	3 338	170	0	3 529	99.4
Ma'ava	Rabbitfish *Siganus argenteus*	11	88	770	3 304	47	0	4 220	79.4
Olomea	Parrotfish *Scarus* spp.	0	8	0	1 937	33	0	1 978	99.6
Pone	Surgeonfish *Acanthurus* spp.	0	0	56	1 315	1 774	0	3 145	98.2
Feke	Octopus	0	64	4	417	437	0	922	92.6
Ngatala	Grouper *Epinephelus* spp.	0	614	19	252	348	0	1 233	48.7
Ta'a	Squirrelfish *Ostichthys* spp.	0	23	3	388	253	0	667	96.1

The units are presumably kg. The text of Vaikona *et al*. (1997) indicates that the “sampled fishermen” represent about 65% of total fishermen.

2.2.5 Regulatory and policy measures relevant to spearfishing

Tonga has a relatively new fisheries act but the regulations currently in force date from the previous act. New regulations have been prepared by the AusAID Tonga Fisheries Project, but (as of November 2005) they have not yet been submitted for Government approval.

The Fisheries Act states that the Fisheries Minister may make regulations covering several topics, including “the use of underwater breathing apparatus and under water torches for night fishing and regulating the use of spear guns and other similar devices”. With respect to regulations:

- The regulations currently in force state “No person shall use self-contained underwater breathing apparatus, or any diving equipment that utilizes compressed gas or surface supplied air, for the purpose of fishing except with the written authorization of the Registrar and in accordance with such conditions as he may specify”.
- The proposed new regulations state: “No person shall use any underwater breathing for the purpose of fishing except with the written authorization of the Secretary and in accordance with such conditions as he may specify”.

Thaman *et al*. (1997) provide some historical background on the regulation of scuba gear:

> Many recent marine resources surveys of Ha'apai have concluded that the use of underwater breathing equipment (scuba and hookah) for commercial harvesting should be banned (e.g. McKoy 1980 for clams; Preston and Lokani 1990 for beche-de-mer). As a result, the Fisheries Regulations of 1994 banned the use for fishing, without the written permission of the Ministry of Fisheries, of both scuba and hookah gear.

Of relevance to spearfishing, the current regulations provide for minimum size limits for lobster, slipper lobster, winged pearl oyster, triton shell, giant clams, beche-de-mer, but not for any finfish. The regulations state that no person shall "use a spear or spear gun for the purpose of capturing, destroying or taking any species of turtle". During the study period, several individuals indicated that spearing lobster is against the law, but this is not the case under the current or proposed regulations.

Tonga's inshore fishing areas are open access and resource-adjacent communities have no preferential user rights. Accordingly, Tongan spearfishers are free to fish wherever they desire, unhindered by any local management rules. The only current exception to this is that, in theory, fishing (including spearfishing) is not allowed in marine parks.

For various reasons, enforcement of most of the legislation related to spearfishing is weak. Although there have been confiscations/prosecutions relating to lobster minimum size limits (mainly by one official of the Ministry of Fisheries), there appears to be considerably less interest in enforcing the other regulations. According to Ministry staff, there has only been one case in recent years of an individual being prosecuted for using scuba gear for diving. The prosecution was successful due to that person pleading guilty. World Bank (2000) indicates that five marine reserves were established in 1979, but in practical terms there is not much difference between these parks and ordinary marine areas with respect to fishing activities, including spearfishing.

2.2.6 Important issues related to spearfishing in Tonga

Some of the important issues related to spearfishing are:

- Given that the Tonga's present open-access regime is likely to continue for a considerable amount of time (especially on Tongatapu) and that population of Tongatapu is likely to continue expanding rapidly, there is some concern that nothing practical can be done about the excessive fishing effort on Tongatapu, the major element of which is spearfishing.
- There are very few controls on spearfishing, and very lax enforcement of ones that do exist.
- Although the use of scuba for spearfishing appears to be contained (or at least not growing significantly), there is some worry that the situation may change if the beche-de-mer fishery and associated scuba use re-commences.
- Under both the present and proposed legislation, it is difficult or impractical to collect the evidence required for a successful prosecution of using scuba for spearfishing.
- Some individuals are concerned about the long-term impacts of visits by industrial-scale spearfishing operations to Tonga's isolated reef areas.
- Spearfishing inside the fish fences for fish which other people considered have already been "caught" is growing.

2.2.7 Some observations and comments on spearfishing and management in Tonga

Spearfishing is a major component of the fishing effort on Tonga's inshore marine resources. While it is generally acknowledged that these resources are overexploited (especially those close to population concentrations), there appears to be some degree of apathy towards applying measures that could reduce fishing pressure. Unlike in Fiji, resort managers (at least those interviewed on Tongatapu) do not seem to have strong feelings about the need for reducing the spearfishing for the benefit of marine tourism.

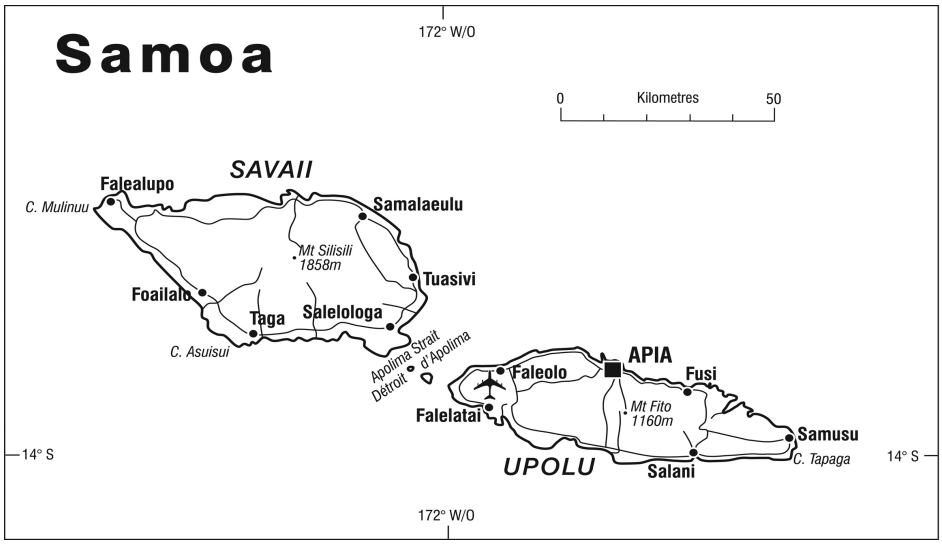
It will not be easy to place new controls on the long-established activity of spearfishing. Accordingly, it may be more practical to improve enforcement of existing controls and prevent the introduction of unfavourable technology. To prevent the widespread use of scuba in spearfishing the Ministry should consider banning the use of scuba for beche-de-mer diving (if the fishery re-opens) and creating a new provision in the Fisheries Regulations which creates an offence for having scuba gear and fishing gear in the same boat or car.

The conflict generated by spearfishing within another group's area does not exist in Tonga, like it does in neighbouring countries. Tonga, however, does not enjoy the resource protection benefits afforded by traditional management. One study concluded:

> "One recommendation over-shadows all others: The failure of centrally-based management [in Tonga], together with the urgent need for some form of management to prevent further declines in coastal resources indicate that a change from the present open access is required. Giving communities the ability to restrict outsiders from fishing in adjacent inshore areas would provide an incentive to conserve resources for the future." (World Bank 2000)

There have been recent moves to give pilot communities in Ha'apai some degree of control over their adjacent marine resources. Although this development is favourable, should be encouraged and is likely to have a positive impact on overfishing (including that from spearfishing), the amount of time required to institute such a major change should not be under-estimated. Parallel measures, such as efforts to improve central management of spearfishing suggested above, should be pursued simultaneously.

2.3 Information on spearfishing in Samoa



2.3.1 Types of information available on spearfishing in Samoa

Various reports by the Fisheries Division (annual reports, specialized studies), the AusAID Samoa Fisheries Project, and FAO give information on the relative importance of spearfishing in Samoa. The report of the 2003 Fisher Creel Census contains a summary of previous studies.

The Fisheries Division has a database containing information from the inshore market surveys. Data can conceivably be extracted from the database that shows the species composition partitioned by gear type in the Apia Fish Market, Fugalei Agricultural Market, Salelologa Market, and along the Apia-Faleolo roadside.

Much of the information in this section on spearfishing in Samoa is from discussions during November 2005 with knowledgeable individuals. These included five fisheries officers, three spearfishers based on Upolu, a dive company operator, a police officer, staff of a coastal environment project, one resort owner, one official of the Secretariat of the Pacific Regional Environment Programme (SPREP), and two individuals knowledgeable on Samoa fisheries.

2.3.2 General structure of the spear fishery in Samoa

There are two very different types of spearfishing in Samoa:

- Village-based spearfishing: This is largely for subsistence purposes but when large catches are made, the fish is often sold within the village or, less commonly, taken to urban markets for sale. Gear is simple, with most divers using mask/fins/snorkel and a sling-type spear. The use of wetsuits is not common. Passfield (2001) states that "groups of fishermen often travel by canoe to an area of the lagoon, and then collectively dive and spear fish as a group. At other times, individuals swim out from shore and spear fish in the lagoon. Night spearing is also common in some villages, using underwater torches".
- Commercial scuba spearfishing: Presently, 18 divers use scuba gear in conjunction with two alia vessels to dive at night at various locations that are rotated. The usual fishing trip is one night, but this can be extended if adequate ice is available. Most divers use sling-type spears, rather than spear guns, because they feel that the guns are too cumbersome and take too long to re-load. Most divers have wetsuits but these are sometimes not used when conditions are warm.

2.3.3 Village-based spearfishing

Subsistence spearfishing has long been an important fishing method in villages in Samoa. Mulipola (2003), using various studies, gives data on the historical significance of spearfishing:

- A preliminary survey of the inshore fishery on Upolu Island in 1983 indicated that "spearing which entailed skin diving" accounted for 50percent of the inshore catch, nets 31 percent; hook and line 16 percent; and gleaning or collection 4 percent.
- The FAO-sponsored survey of Upolu in 1991 gave similar results; spearfishing was responsible for half of the catch.
- An assessment of the subsistence fisheries in Savaii 1996-1997 showed that spear fishing was the dominant (56%) fishing method used in fishing.
- The 2003 creel survey covered a total of 112 villages in Upolu, Savaii, and Manono. It showed that spearfishing (32% of total fishers) was the main fishing method employed and predominantly (89%) occurred in lagoons (inner and outer) and on reef patches, fringing and barrier reefs. A spear with an attached elastic band was the main gear utilized, which landed about 42 percent of the total subsistence catches by weight.

In November 2000 a survey of village fisheries in Samoa was undertaken. The results showed that, both in terms of hours of fishing and of number of fishing trips, "spearing or diving" was the most important fishing technique (Figure 8).

Figure 8: Importance of fishing method by trips and hours

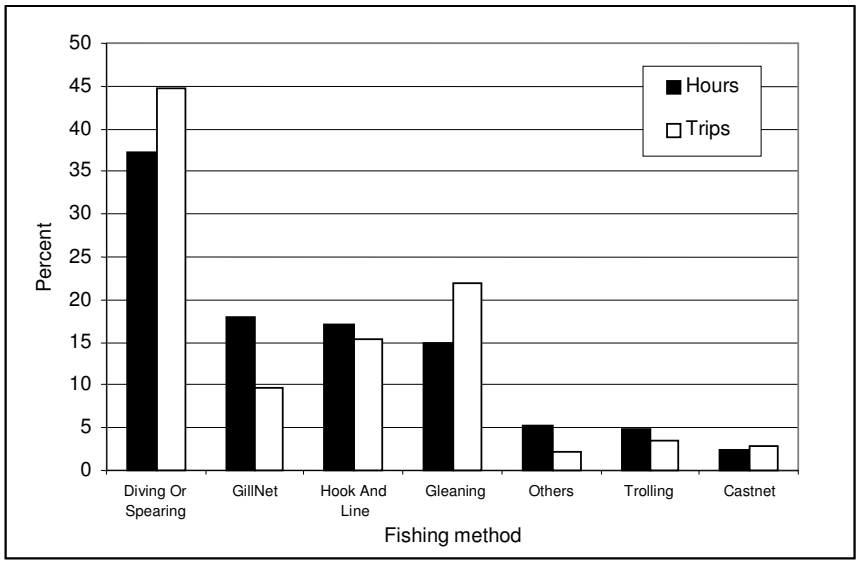


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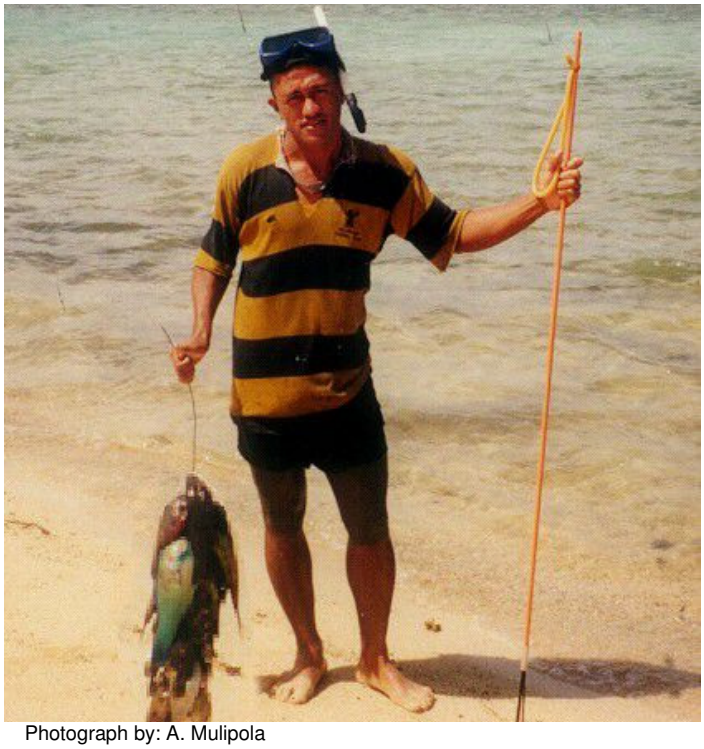
Figure 9: A Village-based spearfisher and his catch



Photograph by: A. Mulipola

2.3.4 Commercial scuba spearfishing

Commercial spearfishing began in Samoa in the late-1980s when the staff of a commercial diving company began using the company's scuba gear for fishing during their free time. Over the following years those individuals increased their fishing activities, began using alia fishing craft, and were joined by other divers.

In 2001 the Samoa Fisheries Project reported: "There has been a rapid increase in the past 12 months in scuba spearfishing. This is conducted at night, and a large number of the

bigger fish responsible for a lot of the recruitment of juveniles are being taken. In particular these include the larger parrotfish *Bolbometopon muricatum, Scarus microrhinos*, and *Cetoscarus bicolor*, the large coral trout, *Plectropomus leopardus*, and the humphead wrasse, *Cheilinus undulatus*. Up to 40 scuba tanks per day are seen to be unloaded at the Apia fish market (Figure 10). Assuming five days fishing per week, it is likely that between 100 and 200 tanks are used per week" (Samoa Fisheries Project, 2001).

Figure 10: Unloading scuba tanks from an Alia at the Apia fish market

Photograph by: A. Mulipola

Discussions with divers in November 2005 indicate that there are 18 active commercial scuba spearfishers in Samoa. The catch per diver per night can range from 40 to 200 kg, which is mostly sold for S$2.70 per kg. The catch goes largely to three shops in Apia, two exporters (American Samoa and New Zealand markets), and the Apia fish market (when fish in the market are scarce). Divers work from two alia fishing craft of the Kionasina Fishing Association, which is owned by the divers. The association is supported by each member diver contributing the proceeds of diving one night per month. According to officials of the association, they have internal rules that require the divers to refrain from fishing any site more than once per month. The alia craft used for diving are often temporarily based outside of Apia, during which time the catches are transported to the urban markets by truck.

Several events in the last ten years caused the government to take action to control scuba fishing:

- Scuba spearfishing adjacent to villages sometimes generated conflict with the residents who perceived that the scuba fishers were taking "their" fish.
- Various environmental groups (NGOs, IUCN project, Environment Department, SPREP) became increasingly vocal as to the negative aspects of scuba fishing.
- American Samoa banned scuba spearfishing which resulted in additional anti-scuba publicity and some of the displaced divers transferred to Samoa (Section 3.1).
- Aleipata district officials lobbied the government for a scuba fishing ban in their area
- The AusAID Samoa Fisheries Project at the Fisheries Division became interested in the scuba fishing issue, examined some of the associated problems, and proposed some management interventions.

As a result, the Government of Samoa intervened in 2003 with regulations that ban scuba fishing except for scientific purposes. A ministerial intervention was subsequently made to examine the possibility of allowing the spearfishers then participating in the fishery to continue their activities. According to the officer responsible for enforcement at the Fisheries Division, the Kionasina Fishing Association applied for a licence in April 2003 but the

application is still pending. According to officials of the Association, a licence for an indefinite period has been issued.

2.3.5 Target species

Discussions with spearfishers indicate that all fish species encountered are "target species". If a choice has to be made as to which fish among several should be shot, the larger fish, regardless of species, would be targeted.

The Fisheries Division's database from the inshore market surveys could theoretically be used to determine the important species caught by spearfishing. However, during the visit to Samoa, the Fisheries Division staff experienced trouble extracting from the database information on landings by gear type. Consequently, discussions with Fisheries Division staff and spearfishers were used to obtain a qualitative appreciation of the important species in the spearfishing catch.

Fisheries Division staff and the divers seem to agree on the most important spearfishing species in Samoa. These are given in Table 4.

Table 4: Common species in the spearfishing catch

Samoan name	English name	Scientific name	Comment
Alogo	Lined surgeonfish	*Acanthurus lineatus*	Very important in catch
Pone	Striated surgeonfish	*Ctenochaetus striatus*	Very important in catch
Fuga	Five-banded parrotfish	*Scarus ghobban*	Very important in catch
Saesae	Unicornfish	*Naso* spp.	
Laea	Parrotfish	*Scarus* spp.	Probably a small form of fuga
Ume	Long-nosed Unicornfish	*Naso unicornis*	

English names from the poster "Samoan Fisheries" by AusAID

Invertebrates of value (e.g. giant clams, lobsters) are taken whenever encountered.

2.3.6 Spearfishing relative to other sources of fishing mortality

The inability to extract catch information from the inshore market survey database by gear and species during the study visit creates difficulties in determining the sources of fishing mortality on the commonly speared fish species. Discussions with Fisheries Division staff and spearfishers were inconclusive. The spearfishers interviewed indicated that spearfishing was responsible for 100 percent of the landings on the above six species. Fisheries Division staff (who may have a better perspective on the situation) stated that about 20 percent of catch of the above parrotfish and about 5 percent of the catch of the above surgeonfish and unicornfish come from fishing methods other than spearfishing.

2.3.7 Regulatory and policy measures relevant to spearfishing

Both national government and traditional measures are used to regulate aspects of spearfishing. The national interventions include:

- The Fishing (Scuba Fishing) Regulations 2003 state: "No person shall scuba fish without a licence…..The Director shall be authorized to issue a licence to scuba fish only for a scientific purpose and for no other purpose".
- Local Fisheries Regulations 1995 establish minimum size limits for a variety of fish, including many that are commonly speared: parrotfish (200 mm), surgeonfish (200 mm), unicornfish (200 mm), and lobster (140 mm tail length, 80 mm head length);they also give the Director of Agriculture the power to establish closed seasons for several species of fish including groupers.

According to the individual responsible for enforcement at the Fisheries Division, there has never been a prosecution under the regulations for using scuba gear for fishing. The 2004/2005 Annual Report of the Fisheries Division (Fisheries Division 2005) states that in the one-year period, there were 106 reported violations of the fisheries regulations, including 73 for undersized fish. According to fishery officers, most of the undersize fish were from spearfishing.

Many different types of traditional rules governing fisheries exist in the 324 villages of Samoa. The 230 coastal villages have a variety of management interventions that affect spearfishing. King *et al*. (2001) review the measures taken by those villages that have fisheries management plans (about 30% of all coastal villages). Those of relevance to spearfishing include:

- establishing small protected areas in which all fishing is banned; (86% of the villages);
- banning the capture of fish less than a minimum size(41% of the villages); and
- restricting the use of underwater torches for spearfishing at night (21% of the villages).

In Aleipata, district officials used traditional management to discourage scuba spearfishing in their area. They ordered villages to block beach access so scuba fishers had difficultly landing their catch.

2.3.8 Important issues related to spearfishing in Samoa

Some of the important issues related to spearfishing are:

- Balancing the need to protect Samoa's inshore fisheries from the deleterious effects of spearfishing with the political directive to allow the existing group of spearfishers to continue.
- Reconciling the village by-laws (which may ban scuba spearfishing) with the national level de-facto permission granted to a group of scuba spearfishers
- The need for the Fisheries Division to design a data collection scheme for the programme of "scientific scuba spearfishing".
- The difficulty of reducing fishing effort from a variety of inshore fishing techniques, the most important of which is spearfishing.
- Whether the export of inshore fisheries resources (an important component of which is the catch from spearfishing), is justified.

2.3.9 Some observations and comments on spearfishing and management in Samoa

In Samoa, the vast majority of controversy, conflicts, and problems associated with spearfishing are due to the use of scuba gear. The opposition to spearfishing in the country seems very large and consists of a range of entities, including villages, district administrations, NGOs, environmental projects, and the leadership of the Fisheries Division. The Fishing (Scuba Fishing) Regulations 2003 are very clear on the scuba ban, the one possible exception to the ban, and the licence required for the exception. The existing scuba spearfishing operation is obviously not for a "scientific purpose"; however, even if it is so oriented, no licence has been issued as required by the regulations. Discussions during the study lead to the conclusion that outrage amongst the scuba opposition is not occurring simply because many of those do not know that scuba spearfishing is continuing, probably because of the semi-cryptic nature of the present scuba spearfishing (fishing at night, away from Apia and delivery of fish by truck to the markets).

In their defence, the scuba fishers have several points. They claim that:

- the small number of divers presently permitted is not a threat to the resource;
- scuba spearfishing is more selective than conventional spearfishing;

- the location rotation system (no more than one night's fishing per month at any site) is self-policed (one week ban on divers violating this agreement);
- over twenty years, the divers have not noticed a resource decline;
- a ban on scuba diving would unfairly impact the livelihoods of many men.

Without actually articulating the concept, the divers have outlined a system for limited entry in a small-scale commercial fishery – an idea that is not without some merit.

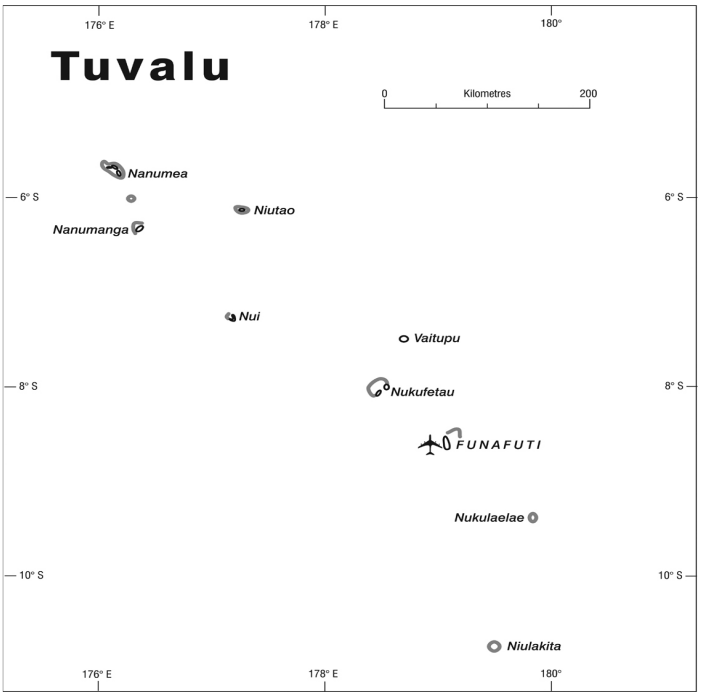
Aside from issues of equitable access to limited inshore fish resources (villagers vs. urban-based commercial divers), it is difficult to justify the use of very efficient fishing gear in reef areas that are already under considerable pressure. A study cited in Mulipola (2003) concluded that "the inshore stocks [of Samoa] were overfished, but the upper slopes appeared to be important refuges for many reefs fish species and probably provided recruits for the heavily fished shallow reefs and lagoons". It is likely that the use of scuba gear reduces considerably this refuge effect.

Another important aspect of scuba use concerns safety. Despite the best attempts of government agencies, allowing the use of scuba in small-scale fisheries will inevitably result in the use of that gear by unqualified and/or careless people and the accompanying injury and death. At least two scuba fishers in Samoa have died.

The Fisheries Division is in a difficult position with respect to scuba spearfishing – attempting to respond to a legitimate intervention from the Minister while at the same time undertaking an obligation to enforce the fisheries regulations. The fact that a new Minister has been appointed creates an opportunity for the Fisheries Division to adjust their position on this issue.

Aside from the scuba spearfishing issue, inshore fisheries management situation in Samoa is in relatively good shape compared to that of its neighbours and remarkable progress has been made during the previous decade. Still, significant problems remain – such as excess fishing effort (much of which is from spearfishing) and the extra demand created by the export of reef fish which serves to increase effort. Fisheries specialists in the major recipient country (American Samoa) recognize the issue and indicate a need to "develop a policy about imported coral reef fish - we shouldn't transfer our overfishing problem to a neighbouring country by importing their coral reef fish" (Craig 2005).

2.4 Information on spearfishing in Tuvalu



2.4.1 Types of information available on spearfishing in Tuvalu

There is little documentation available on spearfishing in Tuvalu. Zann (1981), Lambeth (2000), Finikaso (2004), and Sauni (2005) provide very brief descriptions of spearfishing. Fishery statistics are not presently collected and even the estimates of the production from all types of inshore fisheries are crude at best. Belhadjali (1995) and Johannes (2000) provide some information on the traditional management of inshore fisheries, including spearfishing. Descriptions of traditional fishing in Tuvalu from earlier periods (Alexander, 1902; Kennedy, 1930) contain no mention of spearfishing. SPC's Reef Fisheries Observatory carried out fieldwork in Tuvalu and during the project's socio-economic field surveys collected some information relevant to spearfishing (Kronen *et al.*, 2005).

Much of the information in this section on spearfishing in Tuvalu is from discussions during November 2005 with knowledgeable individuals. These included one official of the Ministry of Natural Resources, four officials of the Fisheries Department, two officials from the Department of Environment, a biodiversity specialist, a former Environmental Adviser, three commercial fishers, a staff member of the patrol boat programme, a fish vendor, and three traditional leaders from the outer islands.

2.4.2 General structure of the spear fishery in Tuvalu

Spearfishing is an important fishing technique in Tuvalu. The fishing method is used during the day and at night in both the lagoon and on the ocean side of the nine islands in the country (Figure 11). Fairly simple gear is used by fishers in the eight outer islands (mainly for subsistence but some fish is sold), as well as on Funafuti (some for subsistence but most fish is sold). Although modern spearguns are occasionally used, most fishers use sling-type spears (Figure 12) in which the rubber is not fixed to the spear shaft. These spears are mainly constructed by the divers themselves. The spear tips (some single, some triple) are sharpened before each spearfishing session. Very young divers sometimes make their small spears from old umbrella frames. Scuba gear is not used, but one set of hookah gear, leftover from beche-de-mer fishing in the mid-1990s, has been employed for spearfishing.

Figure 11: Part of Funafuti Atoll

Spearfishing occurs on both ocean side (left) and the lagoon side (right)

Most commercial fishers on Funafuti use a variety of fishing techniques. The decision of which specific technique to use (spearfishing, bottomfishing, netting, trolling) depends on a number of factors, including market conditions, weather, and the phase of the moon. Spearfishing at night is encouraged by dark moon conditions and a lack of lobster in restaurants, while daytime spearfishing is encouraged by a full moon.

Little data are available on the amount of the spearfishing catch in Tuvalu. Speared fish are an important component of the total inshore fisheries production, but even information on total inshore fisheries landings is not readily available. Anon (2001) indicates that fishery statistics are not collected in Tuvalu. Gillett and Lightfoot (2001) using information from eight sources make a crude estimate of the production from coastal subsistence fisheries and coastal commercial fisheries of 880 tonnes and 220 tonnes, respectively. Fisheries officers interviewed during the study period feel that somewhere around a quarter of the Funafuti inshore catch is by spearfishing, and that this proportion is probably less on the outer islands. On the other hand, Funafuti commercial fishermen interviewed stated that about half of the Funafuti inshore fisheries production comes from spearfishing. Data from SPC's PROCFish/C socio-economic field surveys indicates that spearfishing is responsible for between ten and twenty percent of the total fish catch in Nukufetau, Vaitupu, Nuitao, and Funafuti.

One well-known fisher indicates that a gang of five or six spearfishers often will catch a combined total of about 50 to 70 kgs at night, or about 20 to 30 kgs during the day. Another fisher says that his gang of five boys averages each night "two to three coolers" or about 80 kg of fish. Most speared fish are sold to the public for A$3 per kg at rudimentary markets (Figure 13), but some species (e.g. parrotfish) receive less. Lobster are speared for home consumption, but grabbed by hand when for sale to restaurants (about A$15 per kg in November 2005). Giant clams are taken on an opportunistic basis, mainly for the commercial fishers' own consumption.

Figure 12: A Tuvalu-style speargun

Figure 13: The sale of speared fish at a small market in Funafuti

With respect to formal documentation on spearfishing in Tuvalu, the following was identified prior to arrival in Funafuti:

- Zann (1981) indicates that boys often use a sling-type spear gun of light steel rod fired by tyre rubbers for underwater fishing. Although quarry is small in size, it is the most productive way of fishing. Larger imported spear guns powered by surgical rubber bands are sometimes used by adult spearfishermen. The males of certain families are noted for their extraordinary powers of underwater endurance.
- Lambeth (2000) indicates that underwater spear fishing using a sling-type spear gun (usually homemade using inner tubes) is practised by men and boys. Torches and spears are occasionally used by women for fishing at night.
- Finikaso (2004) states that for the islands of his study, Funafuti and Vaitupu, spearfishing is the fourth and third most important fishing method, respectively. Most people use modern spearguns.

No Fisheries Department official interviewed for this survey was aware of any other substantive documentation on spearfishing in Tuvalu.

2.4.3 Target species

The spearfishers interviewed indicated that they had no specific target fish, but would take what is generally available, with the exception of parrotfish. There is some reluctance to take parrotfish because “the smell and bleeding” is thought to attract sharks. In addition, the selling price for parrotfish generally less than for most other species.

Discussions with spearfishers, fisheries officers, and a fish vendor were used to identify the most common species in the spearfishing catch. These are given in Table 5.

Lobsters and giant clams are taken when they are encountered, but are targeted when there are special orders for these commodities from restaurants and individuals.

Table 5: Common species in the spearfishing catch

Tuvalu name	English name	Scientific name	Comment
Ume	Long-nosed unicornfish	*Naso unicornis*	Very important in catch
Maninilakau	Orangespine unicornfish	*Naso lituratus*	Very important in catch
Pokapoka	Unicornfish	*Naso sp.*	A black unicornfish
Ponelolo	Lined surgeonfish	*Acanthurus lineatus*	
Kapalagi	Surgeonfish	*Acanthurus sp.*	
Ulafi	Parrotfish	*Scaridae.*	
Laea	Parrotfish	*Scaridae*	
Maiava	Rabbitfish	*Siganus sp.*	Very important in catch
Malau	Soldierfish	*Myripristis sp.*	

English translations of Tuvalu names by Fisheries Department Officials

2.4.4 Significance of spearfishing relative to other sources of fishing mortality

In the absence of fisheries statistics, the only information on the portion of fisheries mortality due to spearfishing comes from qualitative assessments by knowledgeable individuals. For each of the important spearfish species (Table 5), the informants indicated that spearfishing is responsible for most of the catch, perhaps 85 to 95 percent. One of the surgeonfish ("kapalagi") seems to the fish on Table 5 that is most often caught by other gear (netting) – perhaps 15 percent of the catch of this fish.

2.4.5 Regulatory and policy measures relevant to spearfishing

In Tuvalu the regulation of spearfishing could conceivably be carried out by both the central government and by local institutions. Centrally, under the Fisheries Ordinance the Minister responsible for fisheries is empowered to make regulations for the purpose of carrying out the provisions of the Ordinance, including several cited items relevant to spearfishing:

- establishing closed seasons for any area of Tuvalu or for any species of fish;
- limiting the amount, size or weight of fish or any species of fish which may be caught or traded;
- designating prohibited fishing areas for all fish or certain species of fish or certain methods of fishing; and
- prohibiting certain types of fishing gear or methods of fishing.

FFA (2000) indicates that no such regulations have been made, apart from regulations in 1990 to prohibit all fishing for trochus of the species *Trochus niloticus*. It is also stated that overall there is very little regulation of fisheries in Tuvalu, except that relating to the licensing of foreign fishing vessels.

There is currently no legislation prohibiting the use of scuba gear for fishing. Some fishers, however, feel that there is such a regulation. The idea of banning scuba gear for fishing has been around for a while. Ten years ago Belhadjali (1995) stated "the proposal for regulating the use of scuba and hookah gear for commercial harvest of marine organisms has been considered for quite some time in Tuvalu". Officials of the Ministry of Natural Resource are currently uncertain about the need to ban scuba fishing. They feel that the need for conservation of fisheries resources must be reconciled with the efficiency of the gear, the associated economic opportunities, and the lack of alternatives for commercializing of fisheries.

The Environment Department has no basic law to underpin its work, but anticipates having some legislation in place in early 2006. It is likely that this will include provisions to allow for the regulation of inshore fishing. Staff of the Environment Department expressed the opinion that such an environment law is necessary because the Fisheries Department's production orientation does not allow it to focus on resource protection.

With respect to island-level regulation of spearfishing, Belhadjali (1995) states that island councils, under the authority of the Local Government Act, can regulate inshore fishing. The island councils of several of the islands have used this power to regulate spearfishing through periodic or permanent bans. In addition, some of the islands have a parallel system of governance in which a council of chiefs exercise control over aspects of island life, including fishing practices. For example, on Nanumaga Islands the council of chiefs has banned the use of spears.

Johannes (2000) examines traditional fisheries management in Tuvalu. He indicates that Section l of Schedule 3 of the national government's Local Government Act, permits island councils "to provide for the improvement and control of fishing and related industries" and "to prohibit, restrict or regulate the hunting, capture, killing or sale of animals, reptiles, bird or fish or any specified kind of animal, reptile, bird or fish." He concludes that conservation in Tuvalu is largely the responsibility of the people of each island and gives information on the various islands. With respect to spearfishing management, he makes the following observations.

- Nukulaelae: The Control of Faapuku and Kaumu Bye-Law of l984, fishing with nets or spear for faapuku (*Epinephelus macrospilos)* and kaumu (possibly *Epinephelus merra*) is prohibited June through August. Some informants suggested that spear fishing has since been banned everywhere and at all time.
- Nukufetau: Spear fishing has supposedly been forbidden, but observance of such laws is not very good on this island.
- Nanumea: The Council of chiefs has banned the use of spears within the reef. This is so the old people can easily get fish with hook and line inside the reefs, while the young people can spear fish along the outer reef slope.
- Nanumaga: In l985 the Council of Chiefs banned the use of spears as well as anchoring on the reef. Observance of these laws is said to be good.
- Niutao: In l987 a bye law was proposed to ban spearing inside the reef, but it is not certain that such a law was enacted.
- Nui: No spearing is allowed anywhere.
- Vaitupu: Spear fishing and net fishing are forbidden.

During the survey period in November 2005, members of two island councils, Nanumea and Nui, were interviewed about local spearfishing rules currently in force. On Nui no spearfishing is allowed. This rule dates from the 1960s when, soon after spearfishing was introduced, the catches by line fishing decreased markedly and fish became more wary. On Nanumea there is currently no rule against spearfishing. At various times in the past, the inshore areas have been closed to spearfishing, leaving the ocean side of the reef open for spearfishing. The last such closure was in the 1980s but, according to the informant, the healthy condition of the inshore fisheries resources has not required a closure in recent years.

Several of the islands' restrictions on spear fishing seem to be oriented to reducing fishing pressure, making fish more available to line fishers, and protecting spawning aggregations. There could also be a generational aspect to the spear/line conflict - old men, who mostly fish with lines, disapproving of spearfishing, mostly done by much younger males.

According to the Funafuti spearfishers interviewed, their atoll has only two rules that affect spearfishing: (a) that all fishers pay an A$100 annual licence fee to the island council and (b) no fishing of any kind is allowed in the Funafuti Conservation Area (FCA), which covers a large area of reef on the western side of the atoll. One of the spearfishers and his wife (a fish vendor) indicated that the FCA is a very good idea – they can see fish, such as rabbitfish, increasing in abundance because of the FCA. Another Funafuti spearfisher offered a somewhat different opinion - that inshore fishing, including spearfishing, cannot be regulated because "so many people from so many islands live on Funafuti".

2.4.6 Important issues related to spearfishing in Tuvalu

Some of the important issues related to spearfishing are the following:

- There is sometimes conflict between spearfishing and other gear (i.e., the contention that spearing reduces the amount of fish available for line fishing, either by reducing the abundance of fish or by making them wary of all fishing gear).
- Reducing Funafuti inshore fishing effort involves great complexity.
- The concept that there are limits to inshore fisheries production is new to many Tuvaluans.
- There is a perception by some government officials that any controls placed on inshore fishing (including spearfishing) by the Fisheries Department could be thought by the general public as being contradictory to the Fisheries Department's development efforts.
- The increased algal growth in the lagoon area around the populated centre of Funafuti could be, at least partially, a result of the removal of herbivorous fish by spearfishing.

2.4.7 Some observations and comments on spearfishing and management in Tuvalu

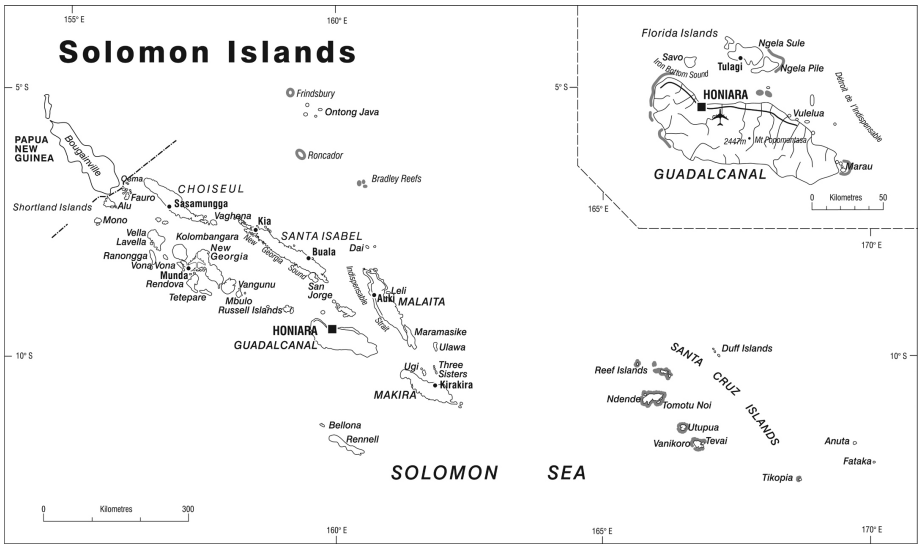
With the exception of spearfishing being an important component of the increasing fishing effort in Funafuti, there are few major problems associated with spearfishing. Two issues of relevance to spearfishing that may become problems in the future are the use of scuba for fishing and the export of reef fish.

Tuvalu seamen return from relatively high paying jobs overseas, and often import such items as automobiles, motorcycles, and outboard engines. There is no reason to believe that scuba gear could not be imported by seamen in the future. Similarly, the more innovative fishermen in Funafuti (many of whom have scuba/hookah experience) could easily commence scuba fishing using existing or newly imported gear. It is likely that the price of fish on Funafuti will rise with increasing demand created by a growing population and that inshore fish will become scarcer. Both of these conditions could create incentives for using scuba/hookah for spearfishing and, given the challenges presently facing the Fisheries Department, it is possible that any action to control scuba spear fishing may come too late. Because a fisheries bill is under consideration in parliament, there is presently an opportunity for being proactive in respect to problems that scuba fishing may cause.

Another threat concerns the resilience of the atoll environment to fishing pressure. The ability of atolls, with characteristically clear water and relatively small inflow of nutrients, to support substantial fisheries production over the long-term is thought to be relatively low compared to areas adjacent to much larger land masses. A significant lesson learned across the Pacific is that atolls and other small islands are unable in the long-term to support substantial export fisheries and that attempts to do so have resulted in lower fish availability for local consumption. An important issue to consider, expressed in simplistic terms, is whether it is appropriate or possible for Tuvalu to use its limited inshore fisheries resources to feed the outside world.

Following from the above two threats, consideration should be given to adding provisions in the fisheries bill to allow the minister responsible for fisheries, should a need arise in the future, to make regulations banning the use of scuba gear for fishing and/or the export of reef fish.

2.5 Information on spearfishing in the Solomon Islands



2.5.1 Types of information available on spearfishing in the Solomon Islands

Spearfishing is not well documented in the Solomon Islands. A number of references mention that spearfishing is an important technique. Inshore fisheries statistics are not collected and the buying records of the fisheries centres are not detailed by gear type. Studies of the live fish fishery and on particular species of fish (e.g. humphead parrotfish) contain information on spearfishing to the extent that they are affected by spearfishing.

Much of the information in this section on spearfishing in the Solomon Islands is from discussions during November 2005 with knowledgeable individuals. These included six officials of the Department of Fisheries and Marine Resources, a former fisheries officer, two divers, a legal specialist, a commercial dive tour operator, two fish vendors, one resort manager, one staff member of an environmental NGO, and several individuals knowledgeable on Solomon fisheries. To reduce any urban bias, interviews were conducted with individuals from remote communities on Wagina, Ontong Java, and the Reef Islands. Significant information was obtained from people who have undertaken fisheries research in the country.

2.5.2 General structure of the spearfishery in the Solomon Islands

Oreihaka and Ramohia (2000) indicate that spearfishing is a common fishing technique in the Solomon Islands. Discussions with officials of the Department of Fisheries and Marine Resources and other individuals who have a good overview of fisheries in the country lead to the impression that, although spearfishing is well known and practised in all coastal areas of the country, it is responsible for only about 5 to 15 percent of national inshore fisheries production. Interviews with residents of the Reef Islands and Ontong Java indicate that spearfishing produces 50% and 80% of the inshore fisheries catch in those areas, respectively.

Subsistence spearfishing is considered important at the village level. One reason advanced by informants is that the costs of participating are low because the fishing technique does not require a boat or canoe or relatively expensive gear. Commercial spearfishing mainly occurs near urban markets, or in areas that have market access. Much of the commercial

spearfishing is done by Gilbertese fishers[15], who fish for small local markets in Wagina, Noro, and Gizo, and ship fish occasionally from those destinations to Honiara.

Spearfishing occurs both day and night for both subsistence and commercial purposes. There appears to be some tendency for subsistence operations to favor the day (no expensive torches/batteries required) and commercial operations the night (greater productivity). In addition to solitary spearfishing, spearing of fish also occurs in conjunction with fish drives using nets or ropes and several fishers.

Spearfishing gear in the Solomon Islands is simple. During the day, villagers typically use goggles or a mask and a sling spear which has no barb and is propelled by inner tube rubber or surgical tubing. Hamilton *et al*. (2005) discuss the gear used at night: "Night-time spear fishers use a variety of equipment, the most basic gear consisting of a pair of goggles, an underwater flashlight, and a handheld steel spear which is thrust into sleeping fish. The most advanced technologies involve the use of underwater flashlights, masks, snorkels, fins and rubber-powered steel spears or short homemade spear guns." Fisheries officers indicate that the use of underwater torches is common, but kerosene lanterns (held out of the water over the immediate diving area) are also used.

Since early 2004 the use scuba for spearfishing in the Solomons has been illegal. Its present use appears to be quite minimal, but this may be more related to economics than the ban (Section 2.5.7 below).

Hamilton (2004) recounts the evolution of a specialized spearfishery for humphead parrotfish (*Bolbometopon muricatum*) in the Rovianna region of the Solomon Islands. Prior to the 1950s, humphead parrotfish were caught by hand spearing from a wooden canoe at night with burning coconut fronds, usually during the new moon. In the 1970s hand held torches were introduced and then mid-1970s underwater torches and associated underwater spearing commenced. Catches increased markedly. In the late 1980s commercialization began with an EU-funded fisheries center and subsequent projects. By the mid-1990s, these humphead parrotfish filets were being purchased at a higher price than any other fish[16]. During the early 2000s these parrotfish were viewed by residents a valuable cash crop, but then problems developed. Major declines in abundance in the last 10 years were noted by all fishers interviewed during the study. The Hamilton report comments that Roviana fishers do not seem to accept the fact that it could be their catches that have caused the decrease in abundance of the parrotfish, but rather feel that it is the changed behaviour of the fish.

Officials of the Department of Fisheries do not encourage spearfishing. They point out that spear holes results in faster bacterial decomposition and that, due to damaged flesh, consumers pay higher prices for the same species caught by line or net fishing.

2.5.3 Target species

Several fisheries officers knowledgeable on spearfishing in the Solomon Islands indicate that there is little targeting of particular fish by either subsistence or commercial fishers. On closer examination, there appears to be at least three types of spearfishing in the Solomon Islands that target particular types of fish. These include operations targeting sleeping humphead parrotfish, grouper spawning aggregations, and pelagic species.

Hamilton (2004) gives the results of creel surveys conducted on nighttime spearfishing at three fishing areas (one site lightly fished, two heavily fished) in the New Georgia Group in 2000-2001. The humphead parrotfish are targeted and made up 56, 25, and 86 percent of

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[15] Gilbertese people were relocated to the Solomon Islands from the Phoenix Group of Kiribati by the British colonial administration in 1963-64.

[16] A person formerly associated with the EU fisheries centres indicated that speared fish were not purchased by the centres, except during certain periods at the Kia station on Isabel Island.

the catch at these three locations, with the highest proportion being for the lightly fished area. In addition to targeting the species, the largest individuals of that species are selected for.

It is well-known that spearfishers in the Solomon Islands sometimes target spawning aggregations. states that aggregating species most commonly targeted by nighttime spear fishers is the squaretail coralgrouper (*P. areolatus)*. This species is a prime target for several reasons, including the fact that *P. areolatus* aggregate in very shallow water on the reef at grouper aggregation sites, are typically inactive at night, and consequently are easy to spear.

A dive tour operator interviewed during the present study stated that tourists who spearfish in the Solomons are highly selective and target "big fish that they cannot get at home, such as dogtooth tuna, barracuda, and yellowfin".

The species composition in the spearfishing catch of the Solomon Islands has not been the subject of a specialized study but the fisheries officers interviewed feel that the catch is primarily surgeonfish, unicornfish, parrotfish, and rabbitfish, with many other fishes of less importance. One researcher indicated that scarids and acanthurids make up a higher percentage of the night spearfishing catch (R. Hamilton, pers. comm., November 2005). A fisheries extension officer from the Reef Islands in Te Motu Province stated that parrotfish and surgeonfish make up most of the catch by spearfishing in his home village. A chief from Ontong Java stated that surgeonfish, unicornfish, and parrotfish make up most of the spearfishing catch. A former fisheries officer, sensitized to grouper resource issues through work on the live food fish trade, indicated that groupers were a relatively minor component of the spearfishing catch.

2.5.4 Significance of spearfishing relative to other sources of fishing mortality

In the absence of fisheries statistics, it is difficult to obtain Information on the significance of spearfishing relative to other sources of fishing mortality. In addition, because spearfishing is less important in the Solomon Islands than in the other countries of this study, fisheries officer are less familiar with the species composition of the catch.

Nevertheless, the individuals interviewed generally had the opinion that only a small amount of the main spearfishing species (acanthurids, scarids, and siganids) were captured by other techniques, but when they were, it was mostly by netting. Research on the humphead parrotfish in the Solomon Islands indicates that almost all fishing mortality is caused by spearfishing with only a few taken in nets.

2.5.5 Regulatory and policy measures relevant to spearfishing

Spearfishing is not specifically addressed in the Fisheries Act 1998, but the Act creates provisions for addressing spearfishing in three ways. The Act:

- gives to the Minister the power to make regulations prescribing fisheries management and conservation measures, including gear standards, minimum and maximum species sizes, limitations on the amount of fish authorized to be caught by any vessel or person or from any fishery, closed season, closed areas, prohibited methods of fishing or fishing gear and schemes for limiting effort in all or any specified fisheries.
- Devolves to provincial governments the responsibility for the proper management and development of the reef, inshore and freshwater fisheries within its provincial waters. This provision of the Fisheries Act in conjunction with the Provincial Government Act 1997 empowers provincial assemblies to make ordinances regulating fishing activities within their area of jurisdiction.
- Recognizes traditional forms of fisheries management.

Using the power of the Fisheries Act, a regulation concerning the use of scuba came into force in January 2004. Regulation 29 states: "Any person using under-water breathing apparatus for the purpose of harvesting any marine resource shall be guilty of an offence and

liable to a fine not exceeding five thousand dollars or six months imprisonment or both such fine and imprisonment."

As an example of a provincial government ordinance relevant to spearfishing, the Makira Province Preservation of Culture and Wildlife Ordinance gives to the Provincial Executive of the Makira Province the power to declare an area to be a protected area. Accordingly, the killing of duck or killing of any fish by means of diving with a spear or a spear gun within one mile radius of the Ulawa area has been banned (Hauirae, 2003).

Traditional fishery management in the Solomon Islands has a large effect on spearfishing. As an example, some communities in the Solomon Islands banned the use of scuba for fishing several years before the January 2004 ban by the central government (World Bank 2000). Luaniua Village on Ontong Java bans spearfishing inside the lagoon due its negative effects on line fishing for sweetlips (Haemulidae). Night spearfishing is identified as a major threat by local communities in the Solomon Islands, and this is typically one of the first activities that is banned at the community level (R. Hamiliton, pers. comm., November 2005).

An important issue with respect to national fisheries legislation and its affect on fisheries practices is the whether fishers know such legislation exists. Oreihaka and Ramohia (2000) state "there is a lack of nation-wide education and awareness on national regulations". Consistent with this observation, there does not appear to be a good understanding of the ban on scuba for spearfishing among even among fisheries specialists in Honiara.

Enforcement is also crucial. At the local level, enforcement of national level fisheries regulations is characteristically weak in the Solomon Islands (World Bank 2000). However, a senior fisheries officer reported that fisheries officers in Western Province apprehended a group of Gilbertese spearfishers using scuba gear several months ago.

A form of spearfishing management was undertaken by the EU fisheries centres. Those centres which did not purchase speared fish, promoted line and net fishing thereby reduced spearfishing effort, or at least discouraged an increase.

Management of spearfishing in the future may benefit significantly from recent research. From studies on spearing humphead parrotfish in the Solomon Islands, Aswani and Hamilton (2003) argue that studying indigenous ecological knowledge has facilitated the selection of a key species and associated habitats that most urgently need management, and the institutional contexts that are most amenable to such management. They indicate that certain area closures (inner lagoon, passage) would provide a measure of protection to the humphead parrotfish.

2.5.6 Important issues related to spearfishing in the Solomon Islands

Compared to other countries of this study, there are fewer contentious matters associated with spearfishing in the Solomon Islands. Nevertheless, there are some issues:

- Spearfishing is an important component of inshore fishing effort and, even in areas away from the urban centres, there is the perception that inshore resource are declining due to fishing pressure. The Oreihaka and Ramohia (2000) study of inshore fisheries across the country concluded that at the village level the "most feared threat is overfishing". Perceived declines in inshore resource were also noted by World Bank (2000).
- Nighttime spearfishing with flashlights is having a major impact on parrotfish and spawning aggregations of groupers.
- There is considerable concern about coral damage associated with spearfishing. Sulu *et al*. (undated) state: "Some traditional fishing practices degrade coral reefs. These include walking and standing on corals when spear fishing or gleaning, breaking corals when retrieving fishing nets, anchoring, and fishing spawning aggregations".

Several fisheries officers and Hamilton (2004) mention damage done to coral during the spearing process.

- At least some fisheries officers feel that spearfishing is wasteful because of the damage to fish flesh and because a spear hole results in faster bacterial decomposition.
- By selective purchasing, buyers of fishery products in the provinces can exert a degree of control over harvesting practices.

2.5.7 Observations and comments on spearfishing and management in the Solomon Islands

The fact that there are not many contentious issues associated with spearfishing in the Solomon Islands could be due to a number of factors. These include very little use of scuba in spearfishing and reduced commercialization of spearfishing due to relatively poor market access.

The spearfishing problems that do exist (as well as difficulties of many other inshore fishing methods) seem to occur mainly at locations that have reasonable access to markets. Presently, this is limited to just a few locations; the fisheries centres at Sege and Yandina, and those places that enjoy good shipping service to Honiara (Gela, Gizo, Noro, and sites on Isabel). To some extent, the inshore fishery resources at other locations are protected by poor market access. As the country develops, this situation is likely to change.

The national government recognizes its limitations in inshore fisheries management, and devolves much authority to lower levels of government. This seems a sensible strategy but should be accompanied by efforts to enhance the capabilities and awareness of the lower level managers.

During December 2005 a ban on the export of beche-de-mer will come into effect. When a similar ban occurred in Tonga in the mid-1990s, that country experienced an increase in commercial spearfishing by displaced divers. This is not likely to occur in the Solomon Islands because the beche-de-mer producing areas, especially Ontong Java, do not have market access for fresh fish (R. Stewart, pers. comm., November 2005).

2.6 Summary of observations in Fiji, Tonga, Samoa, Tuvalu and the Solomon Islands

The observations made on important aspects of spearfishing during the five country visits are summarized in Table 6.

Table 6: Summary of observations on aspects of spearfishing

Country	Major species speared	Scuba use	Major spearfishing difficulties	National management of spearfishing	Local management of spearfishing
Fiji	Parrotfish unicornfish goatfish	Illegal but common	Poaching in traditional fishing areas by urban-based divers; Use of scuba gear; Major contributor to inshore overfishing; Interaction with marine tourism.	Some regulations (minimum size limits, ban on scuba use) but enforcement is weak; Spearfishing exempted from requirement for commercial licence.	Most of the 410 traditional fishing areas have their own local fishing rules and many of those are applicable to spearfishing. Examples are a ban on night diving and a ban on scuba fishing.
Tonga	Parrotfish unicornfish surgeonfish	Illegal but some apparently occurring	Major contributor to inshore overfishing; Lack of option to apply local controls on spearfishing.	Regulations ban scuba fishing and stipulate minimum size limits for some invertebrates but not for any finfish; Enforcement of size limits is weak.	None – communities lack the power to make any local fishery management rules.
Samoa	Parrotfish surgeonfish	Legal only for scientific purposes; 18 active commercial scuba divers.	Conflict generated by commercial scuba spearfishing; Major contributor to inshore overfishing.	Ban on scuba fishing except for scientific purposes; Minimum size limits for a variety of fish,	Many villages regulate spearfishing through such measures as establishing small marine protected areas, banning the capture of fish less than a minimum size, and restricting the use of underwater torches for spearfishing at night.
Tuvalu	Unicornfish rabbitfish	Legal, but none occurring at present	Major contributor to inshore overfishing; Interaction with line fishing	No regulation of inshore fishing	Many island councils have used their authority under the Local Government Act to regulate spearfishing through periodic or permanent bans on spearfishing. Funafuti has a conservation area in which all fishing is banned.
Solomon Islands	Surgeonfish, unicornfish, parrotfish	Illegal; apparently only minimal use	Major contributor to inshore overfishing; The combination of new technology and market access devastating scarids and aggregating groupers.	Regulations ban scuba fishing; Devolution of much authority for inshore fisheries management to lower levels of government	Many villages regulate spearfishing through such measures as bans on night diving and areas closed to spearfishing. Spearfishing and other forms of inshore fishing are often regulated together through seasonal and area bans on all fishing.

3. Information from other Pacific Island countries

Spearfishing is often mentioned in the fisheries literature of the Pacific Islands region. At the national level, this mostly consists of qualitative statements of the importance of the fish method, and occasionally the quantitative results of surveys of fishing gear usage. For some countries, there are good descriptions of spearfishing techniques, such as Johannes (1981) for Palau. Documentation relevant to the management of spearfishing is much harder to obtain.

The scope of the present study allowed for visits to only five Pacific Island countries (Section 2.0). Attempts were made through correspondence to acquire information on spearfishing and its management from other Pacific Island countries. For most of those places, one official of the government fisheries agency and one non-government individual were contacted. At least some information was received from all countries and territories in the Pacific Islands area. These responses are summarized in Appendix 1.

Appendix 1 is a heterogeneous mixture of information ranging from general impression on spearfishing to quantitative results of research programmes. Nevertheless, some conclusions and patterns are evident from the assembled information.

- Spearfishing appears important in all Pacific Island countries and territories. In no country is spearfishing unimportant; nor does any country completely ban spearfishing like some in other regions of the world.
- Other than bans on the use of scuba for spearfishing, there appear to be few, if any, national level rules that apply specifically to spearfishing.
- In some of the more affluent countries/territories of the region (e.g. Guam, New Caledonia, parts of the Cook Islands) recreational spearfishing is quite important.
- Research on aspects of spearfishing by the government fisheries agencies has been carried out largely in the French and American territories. Most of the research relevant to spearfishing in independent countries has been undertaken by NGOs or as academic research.
- It is somewhat ironic that a country which has one of the best fisheries statistical/research capabilities (Guam) does not ban scuba spearfishing, whereas several other countries with limited or non-existent statistical/research programmes ban scuba spearfishing.

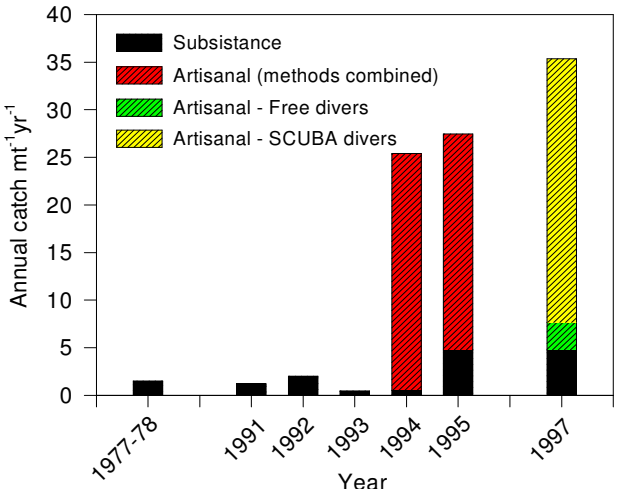
The responses from two locations were especially informative and provided some insight as to the justification for management intervention in spearfishing in two very different environments. These are given in Sections 3.1 and 3.2 below.

3.1 Aspects of management of spearfishing in American Samoa

In the late 1990s research was carried out on parrotfish in American Samoa. The primary objective of this project was to determine the biology, distribution, abundance and life history of parrotfish, a key reef species in American Samoa, and to quantify the impact of fishing pressure on this key reef species assemblage. Analysis of catch statistics, growth data, fisheries models, and reproductive data suggested that populations of parrotfish may be threatened from over fishing, most notably from scuba spearfishing which accounted for an estimated 89% of the total annual yield. The study recommended that the use of scuba spearfishing be outlawed (Page, 1998; M. Page, pers. comm., November 2005).

The perception held by local communities was that teams of nighttime scuba fishermen were working their way around the island, systematically wiping out the reef fish populations. Local villagers were also concerned about their ability to use traditional means to control this boat-based fishery on the reefs in front of their villages at night (Green, 2002).

Figure 14: Estimated annual harvest of Parrotfish on Tutuila Island, American Samoa



(Source: Page (1998) using a variety of primary sources)

A fishery biologist (F. Curren, pers. comm. November 2005) comments:

> In 1996 when I joined American Samoa's Department of Marine and Wildlife Resources (DMWR), commercial scuba spearfishing had just started, primarily around the main island of Tutuila. Another fishery biologist there, Mike Page, studied the effect of scuba spearfishing on the family Scaridae. His final report provided the justification the DMWR Director needed to push for limiting commercial scuba fishing. The Director initially decided to go for a nighttime ban on commercial scuba fishing, which most biological staff felt would be unenforceable. The first hearing concerning the fishing ban had a couple of guest speakers who happened to be on island doing research: Dr Chuck Birkeland and Dr Allison Green. They both testified that a ban on scuba fishing was needed. Most of the people at the meeting (including one commercial scuba fisherman) were in favor of a total ban. The villagers had a proprietary interest in the reefs adjacent to their villages and a tradition of being in charge of those reefs, even when the Territory had the legal rights. Assisting the groundswell of opinion was the fact that most (but not all) of the scuba fishermen were from Tonga. After a couple of meetings, the Director decided to go for a total ban on scuba spearfishing.

The governor of American Samoa created an executive order to prohibit scuba spearfishing starting the following Monday after the public meeting (C. Birkland, pers. comm, November 2005), which was followed by a regulation in January 2002 (Green 2002). After the scuba fishing ban in American Samoa, some of the fishermen moved to the country of Samoa to undertake scuba spearfishing there.

A key point in the discussions leading up to management action against scuba spearfishing was the use of examples from other countries to show that scuba spearfishing is incompatible with healthy parrotfish populations (A. Green, pers. comm, November 2005). In meetings with the Governor and DMWR Director, the cases of Guam and the Great Barrier Reef (GBR) were explained. On Guam scuba spearfishing resulted in large parrotfishes becoming extremely rare or locally extinct, particularly the humphead parrotfish. On the GBR where spearfishing with scuba is banned these species are still present.

3.2 Aspects of management of spearfishing on Satawal Island, FSM

Satawal Island in Yap State of the Federated States of Micronesia is extremely isolated and retains much of its traditions, including those dealing with fishing. A former resident and long-time Satawal observer/adviser (M. McCoy, pers. comm. November 2005) provided the following comments on spearfishing.

> Spearfishing on Satawal is carried out using imported tempered steel spears of from 1.5 to about 1.8 meters in length and surgical tubing slings. The best spears are said to be those that come from pieces of former anti-torpedo netting from World War II that was salvaged in the Chuuk Lagoon. As this material has become more and more rare, there has been a reliance on other imported (and inferior, according to the inhabitants) commercial spears. In recent times (i.e. last 10 years) more efficient, higher-powered commercial spear guns manufactured in Hawaii and elsewhere have been introduced. These guns are usually used by only the best divers, who target larger individuals of surgeonfish species such as *Naso unicornis* and some jacks (Carangidae). The island's reef is resource-poor, and as a result small surgeonfish (Acanthuridae), parrotfish (Scaridae) and damselfish (Pomacendridae) are common targets. Spears are also used to capture octopus, although extraction from their holes is usually with a small (around 30 cm) pick-like tool. Night spearfishing is not practised, as the inhabitants feel it is too dangerous due to the presence of both reef sharks and pelagic sharks.
>
> Spearing is considered by the inhabitants as an efficient means of capturing fish, however it is by no means the only method used. Still, there are times when a ban on spear fishing is decreed by the chiefs, with the intention of preventing resource depletion. Similar bans have been placed on gill nets. The chiefs occasionally ban spearfishing because of a perceived decline in the availability of fish that are usually speared. Bans are put in place for about 6 months to a year. The island's social system enables the acceptance of such bans; a parallel example is the occasional ban on making alcoholic toddy. This is done at times when there is a heavy workload for the men, such as when skipjack are abundant and much fishing with the canoes requiring lots of work and absence from the island, or during a particularly heavy breadfruit season when men are climbing very high trees and cannot have their brains addled by toddy.
>
> These bans, in such a cohesive society, are generally not objected to, and peer pressure ensures that they are followed. The people recognize the problem (in this case the perceived depletion of spearable fish) and while it is a hardship for them in the short-term, they usually understand that action must be taken to ensure the availability of such resources in the future. Another factor in the acceptance of the spearfishing ban is that when such a ban is in place on Satawal Island, it does not apply to West Fayu Island, the primary resource island 50 miles distant where canoe trips are often taken to provide fish and other protein for people on resource-poor Satawal.

4. PROCFish-C results

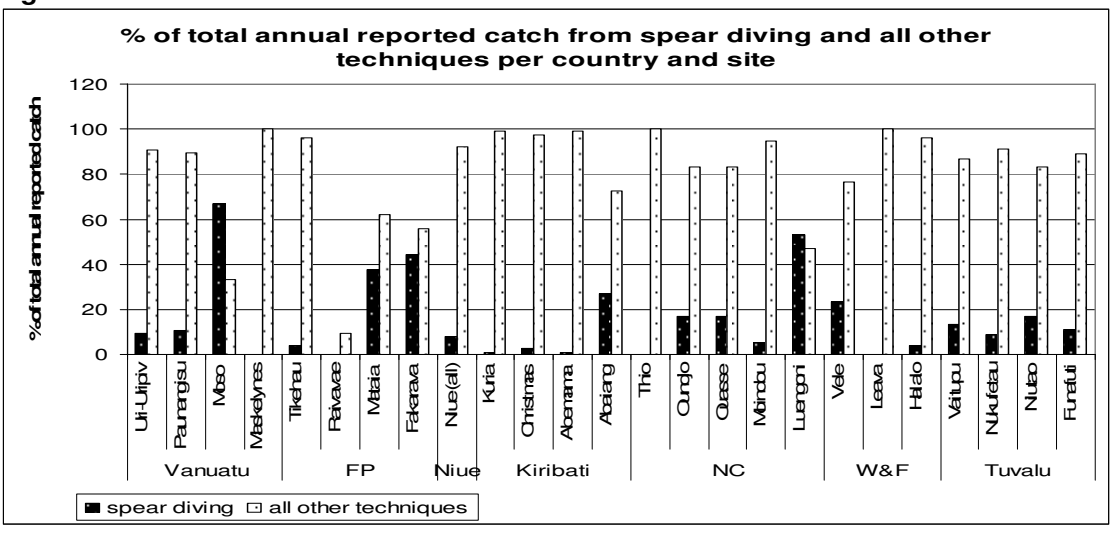
PROCFish-C is a regional multidisciplinary project, funded by the European Union and implemented by the SPC's Reef Fisheries Observatory. The major objective of the project is to establish a regional database on the current status and user level of reef and lagoon resources and to possibly identify useful indicators to help improve subsistence and small-scale artisanal fisheries management in Pacific Island countries.

While spearfishing is not the focus of the PROCFish/C Project, information on spearfishing activity has been collected during the project's socio-economic field surveys. Information given below is derived from the PROCFish/C socio-economic surveys undertaken in seven SPC member countries: Vanuatu, French Polynesia, Niue, Kiribati, New Caledonia, Wallis and Futuna, and Tuvalu. The data set for each country usually covered four communities and was obtained from individual fisher questionnaires. The communities surveyed by PROCFish-C were for the most part rural, predominantly subsistence based and generally not engaging in fishing for commercial purposes. The rural/subsistence orientation of the PROCFish/C socio-economic surveys is useful in the context of the SPC/FAO-FishCode spearfishing study, which to some extent were oriented to urban/commercial spearfishing. The combined results of the two exercises provide a more accurate overview of the spearfishing situation in the region.

The PROCFish/C findings on spearfishing (Kronen *et al*. 2005) show that of a total of 712 fishers (men and women) interviewed, 214 (30%) reported that they spear (dive) fish at some point. Of these 214 people, 68 claimed to be exclusively spear divers, while the remaining 173 frequently use other fishing techniques. In summary, less than 10% of all fishers interviewed exclusively engaged in spear diving.

The relative importance of spearfishing at 25 sites in 7 countries (as indicated by fisher responses) is given in Figure 15. The contribution of spearfishing varies substantially between countries and between sites in some countries. Spear diving seems to be more important in Moso (Vanuatu), Mataia and Fakarava (French Polynesia), Abaiang (Kiribati), Luengoni (New Caledonia) and perhaps Vele (Futuna) than in the Maskelynes (Vanuatu), Raivaevae (French Polynesia), Thio (New Caledonia) and Leava (Futuna). Overall, data from the fisher surveys (pooling data from the seven countries) show that the proportion of stated annual catch by weight attributed to spearfishing makes up only 12 percent of total stated catch.

Figure 15



FP= French Polynesia, NC = New Caledonia, W&F = Wallis and Futuna

Other spearfishing results of the PROCFish/C socio-economic surveys include the following.

- "Spearfishing" includes a number of techniques and gears, and is mostly dominated by low-cost, home or locally made gear rather than commercially purchased modern equipment.
- Scuba spearfishing was not observed or reported in any of the communities studied.
- No instance was encountered where women engaged in underwater spearfishing.

- The CPUE (kg per hour of the entire fishing trip) for spear diving and the average for all other techniques combined, averaged across all sites by habitat, is generally similar.
- The catch composition for spear divers shows that Acanthuridae, Scaridae and Serranidae alone account for about 70% of all reported annual catches. The remaining 30% is attributable to species from more than 20 families with Carangidae, Kyphosidae, Labridae, Lethrinidae, Mullidae, Holocentridae and Lutjanidae dominating. The catch composition of "all other fishers" combined is more evenly distributed.

With the rural community focus of PROCFish/C, differences with the present study are to be expected. Some of the more surprising differences in the results of PROCFish/C are:

- the large portion of scarids in the catch by techniques other than spearfishing;
- the importance of carangids, serranids, and kyphosids; and
- the overall importance of spearfishing.

5. Industrial spearfishing

Spearfishing is generally thought of as a small-scale fishing activity. But what about a 40 metre vessel with dozens of spearfishers? This sort of operation may not be rare in the Pacific Islands region. Consider:

- the JQC Fishing Company fished the fringing reefs of the northern islands in the Northern Mariana Islands for six months in 1995. Prior to this operation, the reef fish populations on these islands were considered virgin stocks. The company used one vessel (110-feet and equipped with ice-making equipment) to launch multi-day, night spearfishing trips to the islands. Alien laborers were used, and spearfishing was done using scuba and/or hookah. Small boats were placed aboard the larger vessel and used to transport the fishers to different reef areas (Green 1997).
- During the present survey, fisheries specialists in Tonga state that every few years there are schemes in which large vessels have been used to transport divers to distant reefs for spearfishing.
- In mid-1993 the *Carpathia*, a 350 tonne fishing vessel registered in the Cook Islands, was arrested by a Tongan patrol vessels at Minerva Reef with 40 Tongan and Fijian fishers aboard, most of whom were spearfishers. A trial was held in the Supreme Court of Tonga in which the owner and captain were found guilty of illegal fishing and were fined T$72,000 and T$24,000 respectively.
- The vessel *Wellbeing No.3* is presently operating in Fiji. It carries 15 divers (mainly from Kadavu Island) and on a recent two-week trip to the islands to the east of Vanua Levu returned to Suva with 16 tonnes of fish. The vessel is reportedly owned and operated by a Korean company, Fishing Fresh World. That company has a second vessel under repair in Fiji and another operating in the Solomon Islands. According to divers aboard the Wellbeing No.3, sometimes (but not always) the spearfishing is done in conjunction with villagers.

Not much is known about the resilience of inshore fishery resources to the pressure from such large scale spearfishing operations. One anecdote may be indicative of the situation:

> Spearfishing using large vessels and many divers was carried out in Fiji's Lau Group in the late 1980s by the commercial arm of Fiji's military. A large amount of fish was transported to Suva for sale. Residents of one of the locations targeted, Ono-i-Lau, claim that inshore fish catch levels remained depressed for several years after being subjected to the large scale spearfishing (T. Waqavakatoga, pers. comm., October 2005).

6. Information from other regions

Although spearfishing is undertaken in many parts of the world, those activities that take place in tropical developing island countries would seem to have the most relevance to the Pacific Islands region. Accordingly, attempts were made to obtain information on spearfishing in the Caribbean and Indian Ocean. Unfortunately, there do not appear to be any regional overviews covering those areas that could be used for comparison purposes. Attempts were therefore made to contact regional fisheries specialists.

For spearfishing issues in the Caribbean, two individuals with comprehensive experience in that region were contacted. They commented as follows.

- With respect to spearfishing in the Caribbean region, we know that it is going on, we suspect that it is quite significant, but we have no real data on how much or what is caught. (R. Mahon, pers. comm., November 2005)
- Spearfishing is prohibited or regulated in most islands of the Caribbean. For example, in the Netherlands Antilles (Aruba, Bonaire, Curacao, Saba, St. Eustatius) and in the British Virgin Islands spearfishing is banned mainly because these countries promote dive tourism and have a system of marine parks and protected areas for this purpose. In many countries the banning of spearfishing was originally promoted by NGOs to protect biodiversity of the coral reefs and fish populations. In general, the final decision to ban spearfishing was often taken to protect the reefs for tourism (including dive tourism) which is priority for development.Tourism provides the main source of income for many Caribbean islands. In addition, the fear of accidents was expressed, which has the potential of seriously affecting the tourist industry. New draft fisheries legislation done for Antigua and Barbuda in June this year (not enacted yet by parliament) requires permission (licence) to use a speargun. Many of the Caribbean countries that do not ban spearfishing want to move in this direction. (B. Chakalall, pers. comm., November 2005)

In two Caribbean countries where spearfishing is legal, there are considerable restrictions. In the Cayman Islands (source: tourism Web site), the use of spear guns without a licence is prohibited; licences are granted only to Caymanians or long-time residents. Visitors may not import or use spear guns in Cayman. No marine life of any kind may be taken while on scuba. In the Bahamas (source: tourism Web site) spearfishing is banned within 200 yards of all Islands in the Bahamas. Spearfishing is restricted to free divers only and only with the use of a Hawaiian sling. It is illegal to use any type of underwater air supply for spearfishing or collecting of any marine life.

In the southwest Indian Ocean, spearfishing is banned in Mauritius, Seychelles, and Kenya. It is thought that spearfishing modifies the behaviour of fish enormously – which is particularly bad in marine parks or where tourists would want to get close to the fish. Where spearfishing is banned, even possession of a speargun is illegal and they cannot be imported or traded. If visitors arrive with one, it is impounded by customs. (D. Ardill, pers. comm., October 2005)

In the Maldives, spearfishing is not important now, nor was it so in the past. Being a tuna fishing nation (and with plenty of tuna to eat all year round) reef fisheries resources were hardly touched prior to the inception of tourism. With the start of tourism in the mid- and late 1970s, spearfishing as a sport was promoted by the tour operators. But soon thereafter government banned spear fishing or importation of any form of spearguns. Spearfishing is now illegal and was not practised as a traditional method of fishing in Maldives. (S. Adam, pers. comm., October 2005)

It appears that there are generally more restrictions on spearfishing in the islands of the Caribbean and Indian Ocean than in the Pacific Islands. The tourism industry seems to have had an important role in promoting these restrictions.

7. The spearfishing catch and associated issues

7.1 Important species

Information is available on the species composition of the spearfishing catch in several Pacific Island countries. This is summarized in Table 7.

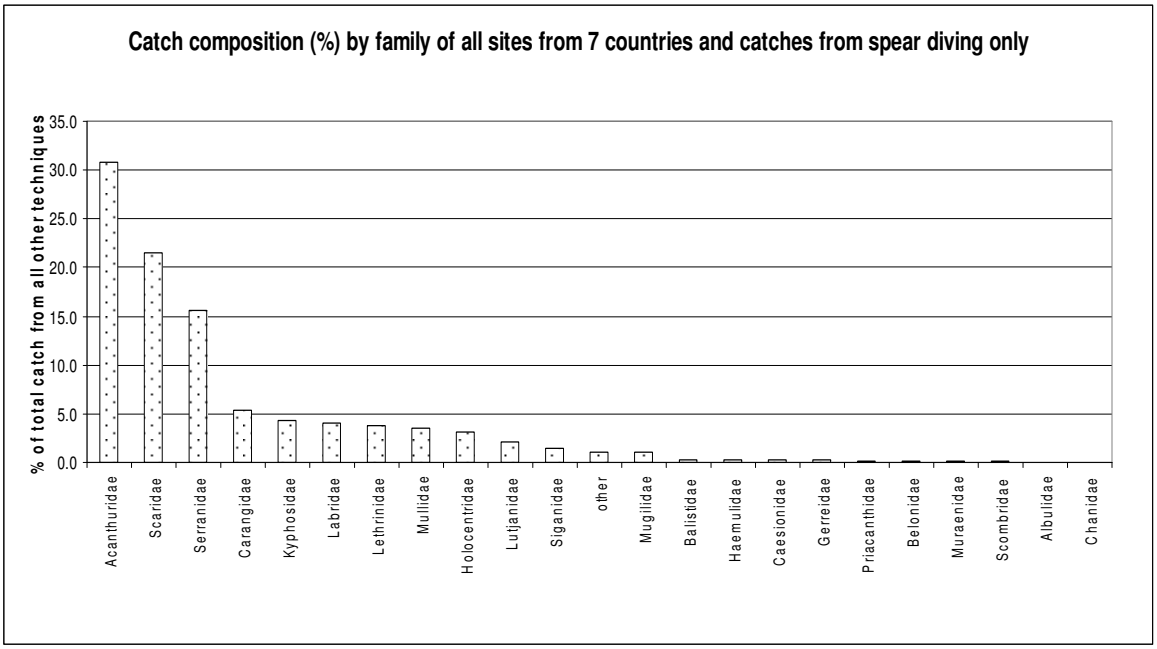
Table 7: Information on spearfishing catch composition

Country	Major components of the catch	Comment/source
Fiji (Dravuni)	Major families are Serranidae, Acanthuridae, Lutjanidae and Carangidae.	Dalzell *et al*. (1996) using several primary sources
Fiji (Ba)	Major families are Lethrinidae, Lutjanidae, Serranidae and Scombridae	Dalzell *et al*. (1996) using several primary sources
Fiji (Suva)	Parrotfish, unicornfish and goatfish dominate.	Qualitative information from discussions with fisheries officers, spearfishers, and fish vendors and observations of catch at Suva markets. Source: present study
Fiji (SW Vanua Levu Island)	Unicornfish, parrotfish, surgeonfish and groupers make up the majority of the combined day/night catch. Surgeonfish appears to be more prevalent during daytime catches, along with squirrelfish, goatfish, moray eels and emperors. When scuba is used, the catch has a higher proportion of groupers, barracuda, carangids and Spanish mackerel.	Qualitative information from discussions with spearfishers and observations of catch. Source: present study
French Polynesia (Society Islands)	The spearfishing catch by family is dominated by surgeonfish (30% of gross tonnage by weight), parrotfish (23%), rabbitfish (14%), and groupers (8%). By species the composition is *Scarus sordidus* and *Scarus* spp. (14.4%), *Naso unicornis* (13.5%), *Siganus argenteus* (7.5%), *Naso lituratus* (5.7%) and *Myripristis* sp. (4.4%)	Results of a 2004 sampling programme in the Society Islands. Source: A. Stein, pers. comm., December 2005
FSM (Woleai Atoll)	Major families are Acanthuridae, Scaridae, Balistidae and Labridae	Results from a remote atoll in Yap State. Source: Smith & Dalzell (1993)
Guam	Most of the spearfishing reef fish catch has consisted of parrotfishes (36%), followed by surgeonfishes (19%), and wrasses (7%). Other important families include the groupers (6%), rudderfishes (5%), snappers (3%), jacks (3%), squirrelfishes (2%), sweetlips (2%) and emperors (2%).	Source: Green (1997) using a variety of references.
Marshall Islands	Spearfishing catch was dominated by Forktail rabbitfish (*Siganus argenteus*) 17% of spearfishing catch; Parrotfish (*Scarus longiceps* and S*carus* spp.) 7%; Dash-dot goatfish (*Parupeneus barberinus*) 7%; Parrotfish (blue&green, *Scarus* spp.) 7%; Surgeonfish (black, *Acanthurus olivaceus* and *Acanthurus* spp.) 7%.	Results of 1994 catch sampling programme at Arno Atoll; Source: G. Joseph pers. comm., November 2005

Country	Major components of the catch	Comment/source
Nauru	Lutjanidae, Holocentridae, Serranidae and Acanthuridae	Dalzell & Debao (1994)
Northern Marianas	During the day, the most abundant families were acanthurids (26% by weight), kyphosids (24%) and scarids (22%), while acanthurids (43%) and scarids (20%) dominated the operation by night.	Results of a research programme carried out over a nine-month period in 1993 on Saipan and Tinian.
Palau	Major families are Scaridae, Serranidae, Acanthuridae and Lethrinidae	Dalzell *et al*. (1996) using several primary sources
PNG (Kavieng)	Major families are Scaridae, Serranidae, Lutjanidae and Haemulidae	Dalzell *et al*. (1996) using several primary sources
PNG (Port Moresby)	Major families are Serranidae, Acanthuridae, Scombridae and Haemulidae	Dalzell *et al*. (1996) using several primary sources
Samoa	Parrotfish and surgeonfish dominate	Qualitative information from discussions with fisheries officers, spearfishers, and fish vendors and observations of catch. Source: present study
Solomons	Surgeonfish, unicornfish and parrotfish dominate	Qualitative information from discussions with fisheries officers, spearfishers, and fish vendors and observations of catch. Source: present study
Tonga	Parrotfish, unicornfish and surgeonfish dominate	Qualitative information from discussions with fisheries officers, spearfishers, and fish vendors and observations of catch. Source: present study
Tuvalu	Major families are unicornfish and rabbitfish	Qualitative information from discussions with fisheries officers, spearfishers, and fish vendors and observations of catch. Source: present study

PROCFish/C (Section 4.0 above) carried out socio-economic surveys in seven Pacific Island countries: Vanuatu, French Polynesia, Niue, Kiribati, New Caledonia, Wallis and Futuna, and Tuvalu. In most of these countries, usually four rural communities were covered. Data collected covered the spearfishing catch composition, which was obtained from individual fisher questionnaires. This information aggregated for the seven countries is shown in Figure 16.

Figure 16: PROCFish/C spearfishing catch composition information



Source: Kronen *et al*. (2005)

The catch composition stated by spearfishers sampled by PROCFish/C in the seven countries (Figure 16) shows that Acanthuridae, Scaridae and Serranidae alone account for about 70% of all stated annual catches. The remaining 30% of the catch is attributable to species from more than 20 families with Carangidae, Kyphosidae, Labridae, Lethrinidae, Mullidae, Holocentridae and Lutjanidae dominating (Kronen *et al*. 2005).

The results of the various studies given in Table 7 are not readily comparable. Some represent the catch from specific locations, while others are estimates of the national spearfishing catch composition. Some studies are based on rigorous sampling, while others use recall of informants or a qualitative inspection of the catch. There are also differences between the various areas studied with respect to factors such as spearfishing gear (e.g. use of scuba) and degree of fishing pressure of locations covered (urban vs. remote locations). Also to be considered is that fish species diversity decreases from the west to the east across the Pacific Islands.

Despite the diverse nature of the above studies, some observations can be made on the species composition of the spearfishing catch. These include:

- The families Acanthuridae and Scaridae seem to be responsible for most of the spearfishing catch in most of the studies.
- The families Siganidae and Serranidae seem quite important in some countries, but apparently much less important in others.
- A large number of other species make up the remainder of the catch.

One interesting feature of the catch composition of spearfishing that may have some management implications is shown by the work of the present study in Fiji. Depending on weather and other condition, spearfishers based in Suva either fish nearby areas on Viti Levu where there is considerable fishing pressure, or go to distant offshore islands where there is relatively little fishing.

- Large parrotfish (Scaridae) and large unicornfish (*Naso* spp.) dominate the catches that originate from distant islands. Minor components include squirrelfish (Holocentridae), rabbitfish (*Siganus* spp.), surgeonfish (*Acanthurus* spp., mainly large individuals), groupers (Serranidae, mainly small individuals, but occasionally some large fish), emperors (*Lenthrinus* spp.), and the red bass (*Lutjanus bohar).*

- A large number of species, generally of small size, are characteristic of spearfishing catches of reefs near Suva. Parrotfish (Scaridae) are a major component, along with goatfish (Mullidae) and surgeonfish (*Acanthurus* spp.). Many other species are present, but the most common during late October 2005 appear to be small groupers (Seranidae), squirrelfish (Holocentridae), rabbitfish (*Siganus* spp.), and emperors (*Lenthrinus* spp.).

With respect to fish spawning aggregations, it appears that a fish often targeted by spearfishers is the squaretail coralgrouper (*Plectropomus areolatus*), (R. Hamilton and Y. Sadovy, pers. comm., November 2005).

Invertebrates are often overlooked in the sampling programmes that produce information on spearfishing catches. Many invertebrates are not actually "speared" but rather collected, hence some uncertainty over classifying the catch as part of the spearfishing fishery. Most spearfishers interviewed in Fiji, Tonga, Samoa, Tuvalu, and the Solomon Islands for the present study indicated that any economically important invertebrates are collected. Green (1997) using a variety of sources, indicates that invertebrates make up ten percent of the Guam spearfishing catch, with lobster, trochus, giant clam, and octopus the major components. Lobster sales by spearfishers to local hotels drive the economics of spearfishing in Vava'u, Tonga (P. Mead, pers. comm., October 2005). Many spearfishers in Fiji, Tonga, and elsewhere are former beche de mer divers and a typical spearfishing trip results in few of these holothurian being collected. Rather than spearfishing while waiting for darkness on the fishing grounds, divers based in Suva (where there are several trochus processing factories) often search for trochus.

7.2 Thoughts on spearfishing selectivity

Selectivity can be defined as the ability to target and capture fish by size and species during harvesting operations, allowing bycatch of juvenile fish and non-target species to escape unharmed (Blackhart *et al*., 2005). Conventional fisheries wisdom indicates that a high degree of gear selectivity is favourable and this notion features in several international fisheries agreements (Box 1).

Box 1: Selectivity in international agreements

The **FAO Code of Conduct for Responsible Fisheries** addresses fishing gear selectivity. Article 8.5 of the Code states:

- 8.5.1 States should require that fishing gear, methods and practices, to the extent practicable, are sufficiently selective so as to minimize waste, discards, catch of non-target species, both fish and non-fish species, and impacts on associated or dependent species and that the intent of related regulations is not circumvented by technical devices. In this regard, fishers should cooperate in the development of selective fishing gear and methods. States should ensure that information on new developments and requirements is made available to all fishers.
- 8.5.2 In order to improve selectivity, States should, when drawing up their laws and regulations, take into account the range of selective fishing gear, methods and strategies available to the industry.
- 8.5.3 States and relevant institutions should collaborate in developing standard methodologies for research into fishing gear selectivity, fishing methods and strategies.
- 8.5.4 International cooperation should be encouraged with respect to research programmes for fishing gear selectivity, and fishing methods and strategies, dissemination of the results of such research programmes and the transfer of technology.

Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem encourages *inter alia* research and technology development of fishing gear and practices to improve gear selectivity and reduce adverse impacts of fishing practices on habitat and biological diversity.

The idea that selective fishing gear is intrinsically good applies to spearfishing in the region. One participant at the spearfishing discussion of spearfishing during International Coral Reef Initiative Regional Symposium (ICRI 2000) pointed out that the scuba use in spearfishing was not all bad because "scuba could greatly increase the selectivity of spearfishing".

When analysing Pacific Islands spearfishing in terms of selectivity, there are a number of conceptual issues to consider:

- Globally, the general idea that selective fishing gear is good seems to be because of low wastage (i.e. discarding undesirable fish). In the small-scale fisheries of the Pacific Islands, this concept may be somewhat less relevant because there is little or no discarding of fish and virtually all of the catch is utilized.
- The positive value of selectivity is also to some degree based on the idea that the selected prey can support the extra fishing effort that being a target entails. This is not always the case in the commercial spearfisheries of the Pacific Islands. Targets are often those fish of especially high value and can include endangered/protected species (e.g. turtles), or species that are inherently unable to sustain much fishing pressure, such as the humphead parrotfish (*Bolbometopon muricatum*) or the humphead wrasse (*Cheilinus undulates*).
- The total selectivity of a fishing method is the combined result of (a) the inherent selective properties of the fishing gear, and (b) the way the gear is operated (Bjordal 2002). For spearfishing, it is generally acknowledged that the properties of the gear are highly selective, with some individuals claiming it is the most selective of all fishing gear. However, an important point is that the way in which spearfishing gear is operated largely determines its overall selectivity. In other words, total selectivity depends not so much on highly selective gear, but rather on the selectivity of the spearfisher – something that could be very different.

The results of field visits to five Pacific Island countries suggest spearfishers in the region do not appear to be very selective. A typical attitude is "anything of value is a target". The spearfishing selectivity situation in Fiji (Section 2.1.5) appears representative of many areas in the region: "The catch composition largely reflects the fish that are vulnerable to spearing, rather than any selectivity exercised by the fisher: If there is any choice, the fisher will obviously shoot at large individuals and/or high value species, but, according to divers, they do not often have to make this decision". Where there are national level rules that could conceivably affect a spearfisher's selectivity (e.g. minimum fish sizes in Fiji and Samoa), discussions with spearfishers suggest that these do not seem to have much influence.

There are, however, at least some cases where selectivity in spearfishing occurs. In Tuvalu there is some reluctance to spear parrotfish because "the smell and bleeding" is thought to attract sharks. Hamilton (2004) gives the results of creel surveys conducted on nighttime spearfishing at three fishing areas in the New Georgia Group of the Solomon Islands in 2000–2001. The humphead parrotfish are targeted and made up 56, 25, and 86 percent of the catch at these three locations. According to a fisheries official in the Marshall Islands, "Marshallese just love rabbit fish, just ask any Marshallese what is their preferred reef fish". (G. Joseph, pers. comm., November 2005). This preference is apparently translated into spearfishing selectivity – Forktail rabbitfish (*Siganus argenteus*) is the most important species by weight in the spearfishing catch of the Marshall Islands. Fish known to be ciguatoxic fish are actively avoided by spearfishers in all countries. Lastly, there are reports from several locations that spearfishers avoid spearing very large fish out of concern for loss of gear.

7.3 The Selectivity of spearfishing as compared to gillnetting

During the present study on spearfishing in the Pacific Islands the issue of comparing spearfishing to gillnetting arose on several occasions, mainly in the context of which is the most detrimental. This is likely to be the reason why the terms of reference for the present

study require some attention to the issue of selectivity of spearfishing as compared to gillnetting.

Only a limited amount of information is available on the selectivity of spearfishing relative to gillnetting.

- Dalzell *et al*. (1996) cite a study carried out on the South Papuan Barrier Reef that gave the catch composition by artisanal fishing method: spear, hand line, gillnet, drive-in net, and surround net. The study showed that gillnetting captured species from 13 fish families, while spearfishing captures fish from 15 fish families.
- Quantitative information on the species composition in the Tongatapu inshore fish catch by species/gear is given in Vaikona *et al*. (1997). In 1997 spearfishing[17] captured fish from 54 species groups (as recognized by Tongan classification), while handline fish captured 40.

As indicated in Section 7.3 above, one of the reasons that selective fishing gear in general is valued is because it results in less wastage. But this positive feature is diminished in fisheries in which all the catch is utilized, as is the case in Pacific Island spearfishing and gillnetting. It appears that a more crucial issue in comparing spearfishing to gillnetting in the Pacific Islands is whether the specific fish populations exploited by the particular gear can support the fishing pressure. Other factors to be considered in the spear/net comparison are the relative amounts of ghost fishing, collateral environmental damage, fish which escape injured, difficulty of enforcing any management controls, and negative interactions with other forms of fishing. It also has been noted (L. Chapman, pers. comm., January 2006) that in the use of gill nets can involve (a) larger fish falling out of the net once the fish dies or during the hauling process; (b) predation on fish in set nets by other "toothy" species or squid; and (c) fish rotting in the net if it is not checked regularly.

7.4 Sources of fishing mortality for the main species

From Section 7.1 it can be seen that the most important spearfishing fish families are Acanthuridae, Scaridae, and Serranidae. The results of the present survey and that of PROCFish/C socio-economic field surveys were used to gain some idea of the significance of spearfishing in comparison to other sources of fishing mortality for these important fish. The results are shown in Table 8.

The results of the two studies are quite different. This may represent real differences in the fisheries, possibly because of the different areas of focus (urban vs. rural, Section 4.0). Alternatively, the difference (or part of it) could be an artefact of the way in which information was collected by the two studies. The PROCFish/C surveys were based on individual fisher questionnaires regarding the informant's own fishing, whereas the SPC/FAO-FishCode study relied on discussions with spearfishers, fish vendors, and fishery officers (five countries) and the latest annual results of multi-year catch/gear survey (Tonga).

The Tonga catch/gear survey (Section 2.2.4, Table 3) shows that spearfishing is responsible for almost all of the fishing mortality on six out of the seven finfish species (or species groups) commonly caught by spearfishing; about half of the groupers were caught by methods other than spearfishing.

[17] Many of the surveys in Tonga consider the fishing method to be "diving", which is somewhat different than "spearfishing".

Table 8: Percentage of important spearfishing fish caught by spearfishing

Category of fish	Sub-category[18]	Percent of catch by spearfishing in present study	Percent of catch by spearfishing in procfish/c surveys[19]
Acanthuridae			About one-third
	Surgeonfish	Fiji: about 60% Samoa: about 95% Tonga: 98.2% Tuvalu: 85%; 85% to 95%[20] Solomons: almost all	
	Unicornfish	Fiji: about 70% Samoa: about 95% Tonga: 99.4 % Tuvalu: 85 to 95 percent Solomons: almost all	
Scaridae		Fiji: about 70% Samoa: about 80% Tonga: 97.9%; 99.6%[21] Tuvalu: 85 to 95 percent Solomons: almost all	About half
Serranidae		Tonga: 48.7%	About one-quarter

7.5 The catch of low trophic level herbivorous fishes by spearfishing

The terms of reference state for the present study require an examination of the ability of spearfishing gear to take low-trophic level herbivorous fishes compared to hook and line fishing. The only available data encountered during the present study for examining the catch by gear of herbivorous species is from the Tonga Inshore Fisheries Statistics Programme which operated on Tongatapu in the 1990s (Section 2.2.4 above).

Using fish diet information in Carpenter and Niem (1998), the major fish families in the Tonga inshore catch which are herbivorous include the following:

- Siganidae – Primarily herbivorous; progress from feeding on zoo- and phytoplankton as larvae to finer algae as small juveniles and to coarser seaweeds and encrusting algae, and occasionally sea grasses, as adults. However, most will take an animal bait.
- Scaridae – Feed principally on algae and associated material scraped from rocks or dead corals.
- Acanthuridae – Graze diurnally on benthic algae, sometimes on seagrasses.
- Kyphosidae – Herbivorous, feeding primarily on benthic algae.

The amounts of these fish taken by handline fishing and by spearfishing on Tongatapu during 1996 are given in Table 9.

[18] In discussions with spearfishers and fisheries officers, the acanthurids are usually disaggregated into the distinct categories of surgeonfish and unicornfish, hence the sub-categories.
[19] Estimated from Figure 7 in Kronen et al. (2005).
[20] The two Tuvalu estimates represent two categories of surgeonfish
[21] The two Tongan estimates represent two categories of parrotfish

Table 9: 1996 annual catch of herbivorous fish at Tongatapu by gear type

Name	Handline	Night and day spearfishing
Unicornfish *Naso unicornis*	21	3 508
Rabbitfish *Siganus argenteus*	88	3 351
Parrotfish "Olomea" *Scarus* spp.	8	1 970
Parrotfish "Hohomo" *Scarus* spp.	55	4 301
Surgeonfish *Acanthurus* spp.	0	3 089
Drummer *Kyphosus* spp.	0	482
Total	172	16 701

The units are presumably kilograms.

The Tonga study indicates that, for the herbivorous fish common in the inshore catch, spearfishing is much more important than line fishing as a source of fishing mortality.

In some respects, a fishing gear that catches herbivores could conceivably be good because these fish may represent an under-utilized fisheries resource, or because the fish may be from a trophic level more resilient to fishing pressure. This notion is demonstrated by a statement of the Cook Islands Ministry of Marine Resource (MMR 2005) in describing fishing at Aititaki Island: "A complete ban on spearfishing as well as the gillnetting restrictions would cause undue hardship to local people who still depend heavily on fish to keep their family fed. Many species of common fish, particularly the herbivorous fish lower in the food chain, cannot be caught with hook and line."

On the other hand, the removal of herbivorous fish from an area can cause serious problems.

- Page (1998) indicates that herbivores such as acanthurids and scarids have been demonstrated to be important in structuring coral reef ecosystems. Depletion in numbers of these taxa can result in increased filamentous algal production.
- The increased algal growth in the lagoon area around the populated centre of Funafuti (Section 2.4.6 above) could be, at least partially, as a result of the removal of herbivorous fish by spearfishing.
- The climax algal growth that can result from an absence of herbivorous fish is a good place for ciguatera organisms to turn up - they seem to prefer mature algae, not that which is constantly being mowed down by herbivores. (U. Kaly, pers. comm., November 2005).

8. Management of spearfishing

8.1 Major difficulties and issues in spearfishing

The major difficulties with spearfishing in the five countries visited during the present survey, as judged by discussions with spearfishers, fisheries officers, fish vendors, and others, are detailed in Sections 2.1 to 2.5 above. Difficulties in addition to those experienced during country visits are found in the literature and others became apparent during correspondence with fisheries specialists. The ten most important spearfishing difficulties from all these sources appear to be:

- the contribution of spearfishing to inshore overfishing;
- the use of scuba in spearfishing;
- night spearfishing;
- industrial spearfishing;
- negative interaction with line fishing;
- poaching and difficulties of surveillance;

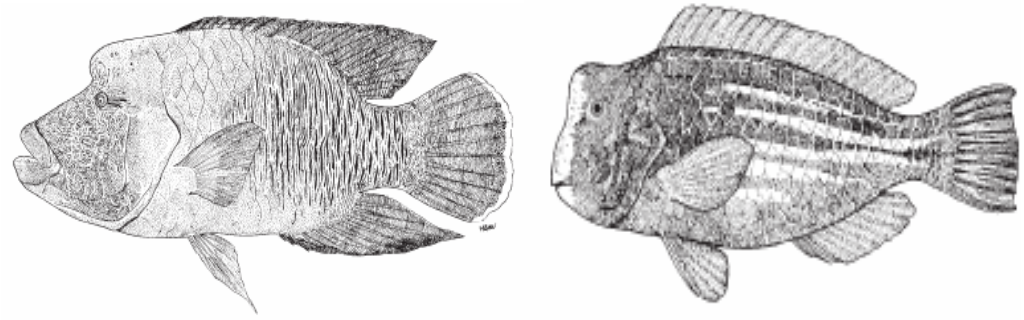
- devastation of certain species;
- devastation of spawning aggregations;
- incompatibility of spearfishing with marine tourism; and
- increased algal growth due to the removal of herbivores.

Table 10 summarizes these difficulties and lists some successes and successes in their mitigation.

Table 10: Spearfishing difficulties and consideration of mitigation measures

Spearfishing Difficulties	Considerations	What has not worked at addressing issue; What may have been over-looked	What has enjoyed at least some success at addressing issue
Spearfishing is a major contributor to inshore overfishing	• Excess inshore fishing effort and associated resource declines are arguably the greatest fishery problem in the region • The problem of inshore overfishing is complex and there are no easy solutions	• National level legislation by itself • Management interventions dealing with spearfishing alone are unlikely to be effective at addressing inshore overfishing • All attempts at controlling effort in open access situations	• Spearfishing must be treated as one of many fishing methods that contribute to the problem. • Providing information/assistance/encouragement to communities for them to address issue
Use of scuba	• Reduces fish populations to low levels • Diminishes/eliminates reserves for fish in deep water • Inevitable use of scuba gear by unqualified and/or careless people and accompanying injury and death	• Simply banning the use of scuba for spearfishing or all fishing, because of difficulties of obtaining evidence for court prosecution • Research on the issue is no guarantee that a ban on scuba will follow (Guam)	• Banning at the national level the possession of scuba and fishing gear in same boat or car • Awareness raising: In rural areas, social pressure to avoid what is considered an unsustainable practice seems more effective than government regulations • Using dive tourism operators to promote/enforce bans
Night spearfishing	• Reduces fish populations to low levels	Attempts to legislate on the national level	Bans at the community level
Industrial spearfishing	• Past or present operations in Fiji, Tonga, Solomons, and N.Marianas use large vessels and many divers • Sequential devastation of fish populations to the detriment of adjacent villages under the guise of development	Assuming that cash provided to villages adequately compensates for resource depletion	Providing information to national authorities on experiences in these operations (e.g. southern Lau in late 1980s)
Negative interaction with hook/line fishing	• Traditional fishers often feel that spearing reduces the amount of fish available for line fishing, either by reducing the abundance of fish or by making them wary of all fishing gear. • Although could be dismissed as not being important, it appears to be perceived to be a significant issue in many traditional areas	Ignoring the generational aspect to the spear/line conflict - old men, who mostly fish with lines, disapproving of spearfishing, mostly done by much younger males.	Communities banning spearfishing in certain areas (e.g. inside lagoon)
Poaching and difficulties of surveillance	Because spearfishing occurs at underwater and often at night, enforcement of any management rules can be difficult and expensive.	Suggestions that national governments should provide boats and fuel to communities for policing usually do not come to fruition, nor do they seem sustainable	• Sensitisation of communities by outside partners as to the value of their coastal resources and the harm done to the resources by poachers. • Sanctions on both boat owners and on spearfishers
Devastating certain species	The humphead parrotfish (*Bolbometopon muricatum*) and the humphead wrasse (*Cheilinus undulates*) seem to be especially unfortunate as they are both high value species and inherently not very resilient to fishing pressure	National level legislation banning commercialization of certain species without significant follow up is not effective even in a capital city	• Local-level bans on night spearfishing • An externally funded marketing project refusing to buy these species
Devastating spawning aggregations	The large numbers of fish taken at some spawning aggregations give the impression that the species is abundant. This can hide the less obvious possibility that, for some species, one or a few large aggregations may represent all the adults in a population (Y. Sadovy, pers. comm., November 2005).	National level legislation by itself	• Creation of an awareness at both the fisheries officer and the community levels of the importance of spawning aggregations and associated protection • Community involvement in establishing marine protected areas that encompass spawning aggregations
Incompatibility of spearfishing and marine tourism	• Spearfishing, whether traditional or modern, catch many of the same fish that are most visible/valued by tourist divers • Even at sustainable levels of fishing effort, spearfishing can have considerable effects on tourism prospects	• Attempting to "win a war with a village"	• Community involvement in establishing marine protected areas that are close to resorts • An economically powerful tourism industry leading initiatives to ban spearfishing entirely, or commercial spearfishing, or by non-residents (some Caribbean and Indian Ocean countries).
Increased algal growth for removal of herbivores	The removal of scarids, acanthurids, and siganids by spearfishing is thought to result in increased abundance of algae	An increase of ciguatera-producing organisms could possibly result	• Some Funafuti, Tuvalu spearfishers report an increase in siganids at some distance from a large MPA

Figure 17: Spearfishing has been especially hard on the humphead wrasse (*Cheilinus undulates,* left side) and the humphead parrotfish (*Bolbometopon muricatum*).



Two issues on Table 10 above require additional mention: spearfishing contribution to inshore overfishing and the use of scuba.

8.2 Spearfishing contributing to inshore overfishing

Spearfishing, being a major component of inshore fishing in the Pacific Islands, contributes to what is arguably the greatest fishery problem in the Pacific Islands – excess inshore fishing effort and associated resource declines. Traditional Pacific Island management systems in many areas dealt with the problem of excess effort but typically these systems have become less effective in recent years due to reduced traditional authority, increased population (especially near urban areas), commercialization, and other factors.

The traditional method of reduction of inshore fishing effort in many areas of the Pacific was often by excluding outsiders. This resulted in fishing effort limitation for subsistence communities because there were limits to how much a community could consume. As communities come into the cash economy, to some extent commercial opportunities for the community (which can be quite large) drive the fishing effort, rather a community's own consumption.

An important aspect of overfishing by spearfishing was mentioned in Section 2.1.9. Over the past few decades there have been a number of changes in spearfishing in the region that have altered its economics: the use of diving goggles, followed by spear guns, diving torches, scuba gear, and any government subsidies for acquiring vessels/outboards. Each of these allows spearfishing to be economic at progressively lower levels fish abundance. In many other fisheries, lowered catch rates usually cause fishers to switch target species or locations before the resource population nears local extinction, but this may not be the case for spearfishing. Night spearfishing and scuba spearfishing may be able to continue even after the fish abundance in an area becomes too low to sustain a viable reproductive population. Dalzell and Schug (2002) cite examples of this occurring in Guam, Palau, American Samoa, and the Federated States of Micronesia.

Today the problem of inshore overfishing is complex and there are no easy solutions. With respect to spearfishing, management interventions dealing with that method alone are unlikely to be effective at addressing inshore overfishing. Rather, spearfishing must be treated as one of many fishing methods (e.g. gillnetting and line fishing) that contribute to the problem. Otherwise, excess fishing effort from one technique is likely to be transferred to another technique in the manner of "pushing one button down, only to have another pop up".

It is beyond the scope of the present study to find solutions to the inshore overfishing problem, but some observations and suggestions can be made.

- National-level management rules seem have little effect on reducing fishing effort by a community in their own fishing area. What seems to work is where communities are aware of long-term benefits of restricting effort, and have strong leadership (World Bank 2000).
- An appropriate role of the national fisheries agency seems to be in facilitating the effort reduction process and providing information to communities, rather than attempting active management.
- Suitable management measures vary from site to site, but a model that appears to be successful could be referred to as "MPA plus" - a community-driven MPA coupled with effort reduction initiatives, such as limits on commercial species, seasonal bans, and prohibition of night spearfishing.

8.3 Scuba spearfishing

One of the most widespread problems associated with spearfishing concerns the use of scuba. The perceived problems associated with using scuba for spearfishing include reducing fish populations to low levels and diminishing or eliminating the positive effects of deep water acting as a sanctuary for fish. Another important issue is that, despite the best attempts of government agencies, allowing the use of scuba in small-scale fisheries will lead to its use by unqualified and/or careless people, with resulting injury and death.

Most Pacific Island countries ban the use of scuba in spearfishing. Where scuba is not banned, it appears to be because: (a) there is no issue as scuba use is minor or non-existent; (b) there is lack of knowledge of its harmful effects; or (c) the scuba divers form an interest group with some degree of political influence.

In most countries that ban scuba spearfishing, a significant amount of such fishing actually takes place illegally. This contention is consistent with the observation at the First Head of Fisheries Meeting (SPC 1999): "The chairman pointed out that it seemed as though most countries already had regulations in place to control or prevent fishing with underwater breathing apparatus, and that most of the problems were in enforcement". Many of the enforcement problems appear due the priorities of the government fishery agency, difficulties in prosecution, and the cryptic nature of the activity (at night, far from shore, on the bottom). People living in villages adjacent to areas in where there is illegal scuba spearfishing (who are characteristically far less affluent than the typical urban-based commercial scuba spearfishers) may carry the burden of the lax enforcement.

In all but two countries the present legislation to ban scuba spearfishing appears inadequate. It is extremely difficult or impractical to collect the evidence required to prove conclusively in court that scuba was used to take fish (i.e. fishery officer underwater observing a fish being speared by a diver using scuba). A much better approach is to ban the possession of scuba and fishing gear in the same boat or car.

Judging from the experience of some of the countries, where scuba spearfishing does not now occur (e.g. Tuvalu), it may be a better, wherever possible, to ban the activity before it has a chance to become well established.

8.4 What works?

Conceptually, the question of what works on the management of spearfishing can be approached on three levels. These are:

- what seems to mitigate specific problems;
- what general types of rules and regulations work; and
- specific examples of management interventions that have apparently been successful.

With respect to mitigating specific problems, Table 10 lists what appear to be the ten most serious difficulties associated with spearfishing and measures (if any) which seem to have some degree of effectiveness in addressing the difficulties. It can be seen that the measures fall into two categories: (a) action at the national level, and (b) action at the community level, often facilitated by assistance from the national level. The effective national level interventions on the table are limited to those dealing with scuba, industrial spearfishing operations, and aspects of marketing to urban areas.

It is also important to consider the general types of management rules that seem to work well. This subject was examined in detail by the World Bank's Comparative Study of Coastal Resource Management in the Pacific Island Region at 31 sites in five Pacific Island countries. The results of that study showed that communities perceive better compliance with some types of management rules than others.

- When national rules are understood and seen as practical and needed, they are sometimes supported by local traditional authority. Expressed in a slightly different way, national rules are sometimes adopted as local rules. When this occurs, the perceived compliance is usually high. A spearfishing-oriented example of this occurs in Fiji. Even though there is a national regulation against the use of scuba in fishing, the Chief of Ucunivanua Village concurrently banned the use of scuba for fishing.
- When national laws *can* be enforced and *are* enforced through buyers and/or exporters, the perceived compliance is high. A spearfishing-oriented example of this occurred in the Solomon Islands with the EU Fisheries Centres (example given below).
- With respect to local community rules, there was a perception of relatively good compliance with simple rules (i.e. full bans with no conditions/exceptions) and with those rules dealing with protected areas, closed seasons, and destructive fishing practices.

It may be useful to mention some apparent successes in managing aspects of spearfishing. The following specific examples are taken from both situations encountered during the fieldwork for the present study, as well as from correspondence with fisheries specialists.

- In the Solomon Islands, there is an example of a management intervention exercised through a buyer. It was the general policy of the EU fisheries centres was to not buy speared fish, and when this policy was in place, the vulnerable humphead parrotfish enjoyed some protection from urban market demand. The amount of protection enjoyed can be appreciated by a centre that began to purchase speared fish. In August 2001, the Bahana Fisheries Centre in Kia started purchasing humphead parrotfish for the first time in the centre's 10-year history. In 16 months, the centre purchased over 31,000 kg of humphead parrotfish, with recorded catches of over 500 kg being regularly landed by a single diving party in a night. (Aswani and Hamilton, 2003)
- An example of another buyer-enforced intervention comes from Tuvalu. Although it is easier to obtain lobster by spearing than by hand, restaurant owners refuse to buy

speared lobster for quality reasons, and consequently no lobsters for commercial purposes are speared.

- The management of spearfishing is made difficult by the high incidence of poaching and difficulties of surveillance. Suva-based spearfishers interviewed during the fieldwork of the present study (Section 2.1.7) indicated that they generally had no fear of being apprehended while fishing unauthorized in the various traditional fishing grounds. They felt that it was quite difficult to be detected, but if so, few villagers had the resources or inclination to chase down the intruding divers and get involved in any subsequent punishment. It is interesting to note that two spearfishers independently stated that the exception to this was at Astrolabe Reef off Kadavu Island. At that location the chance of being detected is far greater and the villagers are "too good at chasing and catching divers". Some follow-up investigation suggested that the increased diligence of the Dravuni villagers could be due to a number of factors. These include sensitisation of the villagers by outside partners (USP, Astrolabe Inc.) as to the value of their coastal resources and the harm done to the resources by poachers. It also seems that a single individual who originates from Dravuni and is well known around Fiji, may have had much to do with inspiring the villagers to take action.
- In the Kubulau area of southwest Vanua Levu Island (Section 2.1.7 above) there seems to be little or no awareness of any government regulations affecting spearfishing. There is no scuba spearfishing occurring despite ready access to the gear. This seems to be because of a feeling amongst the villagers that using scuba is bad. This is apparently brought about by social pressure to avoid what most members of the community feel is an unsustainable practice, rather than because of any government regulation.
- In American Samoa soon after a public consultation on scuba spearfishing, the governor issued an executive order to prohibit scuba spearfishing. The effectiveness of the meeting appeared to be due to several factors, including (a) powerful presentations a couple of guest speakers who happened to be on island doing coral reef research, and (b) the use of both bad and good examples of spearfishing management, Guam and the Great Barrier Reef, respectively.
- In Samoa there is a national ban on scuba spearfishing. For various reasons one group of scuba spearfishers continues operating (Section 2.3). After some awareness creation by an external agency, district officials used traditional management to discourage scuba spearfishing in their area. They ordered villages to block beach access so scuba fishers had difficultly landing their catch.
- Success of management initiatives obviously relates to the objectives of those initiatives. Although it may not be a management objective in the Pacific Islands, action by the economically-important tourism industry in Caribbean was successful in many countries in eliminate spearfishing (or placing very tight controls), something that environment NGOs were unable to do.
- At Satawal Island in the Federated States of Micronesia (Section 3.2) spearfishing and other inshore fishing techniques appears to be effectively controlled to prevent overfishing. This is at least partially due to strong traditional management authority, all stakeholders understanding the reasons for the controls, and having alternative sources of fish for domestic consumption.

8.5 Additional comments on spearfishing management

A recent overview report on the fisheries sector in one Pacific Island country stated:

> The inshore fisheries of the country are dynamic. Many significant changes in resources and fishing activity occur each year, but fisheries management responses to changing circumstance appear to be sluggish at best. If a fishery manager is someone who is aware of the changes in the various fisheries, and who

proposes policy changes and associated management measures to meet the new circumstances, then there is a lack of inshore fisheries managers in the Fisheries Department.

This statement seems especially applicable to spearfishing in the region. Not only does enforcement of existing legislation relevant to spearfishing need to be more rigorous in most countries, but as new spearfishing issues arise, measures to deal with these issues need to be explored, promoted, and championed to fruition. In short, management should be more responsive.

The above does not imply that the central government should be doing all the spearfishing management. Many (or perhaps most) issues dealing with spearfishing and other inshore fishing techniques are best addressed by interventions at the local level. Government fisheries agencies do have an important role in local level management, but it often should be in the form of providing information and facilitating the management process, rather than attempts at rule making and subsequent enforcement.

As an example, night spearfishing could be viewed in this context. Night spearfishing is a serious threat to inshore fisheries resources across the region and many countries are wrestling with how to control it (ICRI 2000). Realistically, however, few if any Pacific Island countries could make and enforce a national law banning the practice. In many countries a more appropriate strategy to control this and other harmful inshore fishing practices would be to create an awareness of the problem at the local community level and encourage local interventions.

Spearfishing has been banned in many tropical developing island countries in the Caribbean and Indian Ocean. This has apparently occurred due to consolidated action by an economically powerful tourism industry, or at least with tourism-oriented objectives in mind. Despite the growing importance of tourism in the Pacific Islands, spearfishing bans do not appear practical in the foreseeable future in this region, where considerations related to indigenous food supply are very important. Marine protected areas near dive areas may represent the most workable mechanism to mitigate the tourism/fisheries conflict.

9. FAO Code of Conduct for Responsible Fisheries issues relevant to spearfishing

Much of the Code is applicable to spearfishing in the Pacific Islands. Sections of particular relevance are noted below.

- States should prevent overfishing and excess fishing capacity and should implement management measures to ensure that fishing effort is commensurate with the productive capacity of the fishery resources and their sustainable utilization. (CCRF Art 6.3)
  Comment: *Overfishing is one of the most serious problems associated with spearfishing in the region.*
- Selective and environmentally safe fishing gear and practices should be further developed and applied, to the extent practicable, in order to maintain biodiversity and to conserve the population structure and aquatic ecosystems and protect fish quality. (CCRF Art 6.6)
  Comment: *Section 7.2 of this report indicates that spearfishing gear is inherently selective, but the total selectivity actually depends on how the gear is used, which is usually not very selectively. The virtues of selectivity, however, are somewhat irrelevant in fisheries that utilize all of the catch.*

- States should establish, within their respective competences and capacities, effective mechanisms for fisheries monitoring, surveillance, control and enforcement to ensure compliance with their conservation and management measures. (CCRF Art 7.1.7)
  Comment: *For some aspects of spearfishing, this is only practical at the local community level.*
- In the case of new or exploratory fisheries, States should adopt as soon as possible cautious conservation and management measures. (CCRF Art 7.5.4)
  Comment: *This has considerable applicability to countries that have neither scuba spearfishing activity nor regulations against it.*
- The performance of all existing fishing gear, methods and practices should be examined and measures taken to ensure that fishing gear, methods and practices which are not consistent with responsible fishing are phased out and replaced with more acceptable alternatives. In this process, particular attention should be given to the impact of such measures on fishing communities, including their ability to exploit the resource. (CCRF Art 7.6.4)
  Comment: *This has applicability to countries that are not doing much about scuba spearfishing activity.*
- The efficacy of conservation and management measures and their possible interactions should be kept under continuous review. Such measures should, as appropriate, be revised or abolished in the light of new information. (CCRF Art 7.6.8)
  Comment: *Most countries of the region need to have more responsive management of inshore fishing, including spearfishing; as spearfishing issues arise, they need to be explored, promoted, and championed to fruition.*

10. The value of launching a special regional initiative on managing spearfisheries

The following represents the personal opinions of the authors, rather than the results of canvassing a large number of Pacific Island fisheries stakeholders.

It is generally acknowledged that a thorough knowledge of the concerned fisheries is a necessary prerequisite for successful fisheries management. In this respect, information on spearfishing beyond what is contained in the present report would certainly be helpful.

This notion, however, must be placed in context. The concept of a special regional initiative on managing spearfishing seems similar to that of SPC's Live Reef Trade Initiative. In that project, substantial resources were focussed on one issue, albeit an important issue. In some respects, the live reef trade may have received a disproportionate amount of attention, to the detriment of other serious coastal fisheries management problems. The same could happen to spearfishing management should there be a dedicated SPC programme on this issue.

As an alternative to a special spearfishing initiative, a strategy that may warrant consideration is to analyse the array of important coastal fisheries management issues, determine the areas where regional and national expertise is lacking, and carry out several specialized "mini-initiatives" in those areas. Examples of this include:

- gillnet fisheries and their management;
- rural fisheries centres and associated fisheries management issues; and
- aquarium/coral fisheries and their management.

11. Concluding remarks

The SPC/FAO-FishCode study indicates that spearfishing is important in Pacific Island inshore fishing. Visits to five countries carried out in the course of the study show that there are very large differences between countries, and between locations within a single country, in the level and type of spearfishing activities. A common feature in each area is that spearfishing is a major contributor to inshore overfishing. In all but the most traditional places there are difficulties with enforcing spearfishing management measures.

A few generalizations on spearfishing management can be made:

- For several reasons, a complete and effective ban of scuba spearfishing and effective enforcement is the single most important spearfishing management measure. Expressed in blant terms, "If a country does nothing else right in spearfishing management, ban the use of scuba".
- Spearfishing effort must be managed along with other forms of inshore fishing. Attempts at restricting just spearfishing are not likely to be successful, as fishing effort may be easily transferred to other small-scale fishing methods.
- In the management of inshore fisheries, including that of spearfishing, only a few measures are likely to be successfully implemented at the national level. Most interventions must be formulated, initiated, and enforced at the local level, preferably with some assistance from the national level.

In the management of Pacific Island inshore fisheries, no single measure is likely to be effective in addressing all the present and future concerns at a particular site. The relative success of the various possible interventions is likely to change over time as conditions evolve. It therefore seems that an effective community-level strategy would be to have a marine protected area along with other interventions such as limits on commercial species, seasonal bans, and prohibition of night spearfishing ("MPA plus").

What kind of advice do countries need to improve the management of specific spearfishing difficulties? The inshore fisheries managers in each country are obviously in a better position to articulate their specific needs than the authors of this report. On a general level, the insight gained during the SPC/FAO-FishCode Spearfishing Study suggests three areas of assistance may be especially productive:

- high quality advice on inshore fisheries management, especially mechanisms to reduce fishing effort.
- Assistance to the fisheries agencies to create an awareness on the part of fisheries officers of the need to be more active and responsive in inshore fisheries management.
- Because much of the management of Pacific Island inshore fisheries (including spearfishing) is likely to take place at the village level, the production of simple well-illustrated guidebooks of important principles and measures for inshore fisheries management would seem appropriate. For specific spearfishing issues, Table 10 of this report could be used as a basis for village level awareness material.

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APPENDIX 1: information on spearfishing from other Pacific Island Countries

The scope of the present study allowed for visits to only five Pacific Island countries (Section 2.0). Attempts were made through correspondence to acquire information on spearfishing and its management from other Pacific Island countries. For most of those places, one official of the government fisheries agency and one non-government individual were contacted. The responses[22] are given in the table below.

Country or territory	Information on spearfishing
Cook Islands	Spear fishing in the Cook Islands has declined since mid to late 90's, largely driven by reef fish becoming ciguatoxic. Some people still shoot fish on some of the outer islands. The main target fish groups in the Cooks are trevallies, parrots, unicornfish, grouper, topsail drummer and [when they are fat] dogtooth. Snappers and maori wrasse are targeted but tend to stay just out of range. While spear fishing fishers shoot at anything of reasonable size that they can eat, some fishers have upgraded their equipment: 3 to 4 rubber powered guns with drop off tips and a bungie cord, they drag broken CD's to attract tuna and target pelagics. Scuba spear fishing has pretty much died, probably less than 10-12 scuba spearing trips occur on the Raro reef slope each month, and it is banned elsewhere in the Cooks. The dive tour operators complain about scuba spear fishers. The Islands of Pukapuka and Rakahanga have banned the use of spearguns in the lagoon, because they wanted to conserve the groupers (I. Bertram, pers. comm., November 2005).
Federated States of Micronesia	Night spearfishing is perhaps the most common form of fishing in Pohnpei and supplies an abundance of fish for the local markets. These markets, although small-scale, number in the 10s, are concentrated primarily in the capitol Kolonia, and are rapidly growing (Rhodes 2003). A survey of fishers in Yap reported a 22% increase in privately owned motorboats between 1986 and 1987 and that seven out of ten households throughout Yap's villages owned spear guns and gill nets. Spear guns have been in use for only several generations and the use of large nets was formerly restricted to community events. Just over 90 percent of villages participate in night spear fishing and just over 70 percent participate in gillnet fishing. The availability of household refrigeration encourages harvest beyond immediate needs (IWP 2002). Spearfishing is one of the most common types of fishing in the FSM, especially in some of the outer islands The FSMers, unlike Palau, do not use spearguns but normally use the rubber/spear type; but they do a lot of night spearfishing with flashlights. In my younger days we used to use torch made from palm fronds, for searching on the reef flats and outside the wave breakers. The use of the underwater flashlight really took off in the 1970s and is now popular to the point where no one uses the palm frond torches anymore. In the 1980s, the introduction of the gill net really changed the scene but most people still use the spear and flashlight for fishing (M. Henry, pers. comm., November 2005). In the outer islands of Yap most of the islands banned flashlight spearfishing (and monofilament gill nets) as they believed the methods were unsustainable in their atoll situations (A. Smith, pers. comm., November 2005).

[22] Some responses edited for clarity and brevity.

Country or territory	Information on spearfishing
French Polynesia	In the Windward Society Islands (Tahiti, Moorea) 44percent of the inshore fish catch is by spearing, while in the Leeward Society Islands the proportion is 22 percent In the Austral, Tuamotu and Marquesas Islands, spearfishing is well developed, but less so than in the Society Islands. Altogether in the Society islands, surgeonfish and parrotfish make up 53 percent of the spearfishing catch. Fishery regulations give the option of banning spotlights for night spearfishing, but this measure has not been implemented to date. Eight MPAs have been established in Moorea and spearfishing is banned in seven of them. (A. Stein, pers. comm., November 2005).
Guam	Three datasets provide information on the spearfishing catch: a commercial receipt book program, inshore creel surveys, and offshore creel surveys. The most problematic aspect of spearfishing is scuba fishing. There have drops in numbers of large groupers, parrotfish, large wrasses, and most every large slow-growing species harvested by scuba spearing. Currently on Guam, some fishers blame sedimentation and non-point source pollution as the primary cause for decline in reef fisheries, and this concept may deflect some of the criticism of scuba spearfishing (T. Flores, pers. comm., November 2005). The range of species targeted by spearfishers is broad and includes nearly all coral reef dwelling fishes >12 cm, crustaceans, molluscs and echinoderms. Over the last ten years, 90 percent of the catch has been reef fish and 10 percent invertebrates. Most of the reef fish catch has consisted of parrotfishes (36%), followed by surgeonfishes (19%), and wrasses (7%). Overall catch rates ranged from 1.4 to 3.1 kg/person-hour from 1985 to 1991, and have risen in recent years to 3.3 to 7.4 lb/person-hour. This is not believed to be indicative of a healthy fishery, because these statistics reflect an increase for non-biological reasons. In the last few years, there has been an increase in commercial spearfishing with scuba at night. These scubafishers have become more successful in recent years, because they are using improved technology (high capacity tanks, high tech lights and bang sticks), which allows them to fish in deeper water of 30-42 meters. (Green 1997, quoting a variety of sources).
Kiribati	In South Tarawa around 15 percent of fishers use spears in fishing, but only 8 percent in north Tarawa (Phillips 1995). Many households have at least one young guy who spears fish. They use the rubber tire sling with steel rod and sharp point, no barbs. They carry the gear (usually 3 spears) and string of fish on a 4' piece of pvc tube with end caps. Most catch is low trophic herbivorous species, particularly if they are spearing for bait for eels - (te rapono) and eel traps (te oo). They just knock off the surgeonfish by the 10s, split them and hang them in the trap. (H. Genthe, pers. comm., November 2005).
Marshall Islands	The intensity of spearfishing has increased about in proportion to population on the outer atolls, but not in Majuro or Kwajalein because human population growth there has far exceeded size of fish stocks. Spearfishing at reefs proximate to villages continues, but by only the best fishers because of scarcity of fish at these locations and difficulty in spearing survivors. Spearfishermen now more commonly walk to island areas where human population is less dense or take boats to reefs bordering uninhabited islands because it's easier to exploit stocks there. Spears and surgical tubing for making Hawaiian-sling type weapons are much more readily available from outer atoll businessmen than they were 15-20 years ago, as well as masks and snorkels. Spearfishing at night has become more common as well (K. Hart, pers. comm., November 2005). Catch sampling from the artisanal fishery at Arno Atoll in 2004 shows that spearfishing was the most important gear type for inshore fishing and was responsible for 37 percent of the inshore catch by weight. The forktail rabbitfish (*Siganus argenteus*) was the most important species by weight and made up 26 percent of the spearfishing catch (G. Joseph, pers. comm., November 2005).

Country or territory	Information on spearfishing
Nauru	Spearfishing with scuba gear grew in popularity during the 1970s and 1980s and there were regularly up to 30 persons a day fishing in this fashion in the past. As fish stocks were depleted, however, this method of fishing was only practised by two groups of fishers. At present only one of these is active on a regular basis as a leader of the other groups has found employment on the construction of the runway extension (Dalzell *et al*., 1992). Spearfishing is very important on Nauru as these are some of the people that are providing household food requirements for Nauruan families. There are no studies that focused on spearfishing on Nauru. Our spearfishing is not yet regulated but plans to introduce community based MPA next year may also cover this fishery (P. Jacobs, pers. comm., November 2005) In April 2005 scuba spearfishing was increasing with young men being self-taught to scuba dive. This was increasing the fishing effort, but fisheries did not have the legislation in place to stop it. Fisheries were not supporting this activity, and would not fill tanks, but there were several other compressors on the island. (L. Chapman, pers. comm., January 2006)
New Caledonia	About 60 percent of the total catch from the southwest lagoon of New Caledonia is caught by recreational fishers, using mainly hand-lines and spear-fishing (Loubens, 1978). It is prohibited by law to have on board a commercial fishing vessel, any kind of gear which may be used for underwater fishing. There is no official commercial catch from spearfishing in New Caledonia, however, it is well known that some species (e.g. spiny lobsters) are currently caught with this gear (R. Etaix-Bonnin, pers. comm., November 2005) The main fishing gear in the New Caledonia lagoon is handline (first choice of 35% of respondents) and spearguns (first choice of 24% of respondents). In South Province, spearguns are the gear of choice (Virly 2000).
Niue	Of 522 households surveyed in September 1989, 320 reported undertaking some form of fishing activity in that month. Most fishing trips were conducted on the shore (1,359 trips) or by canoe (1,121 trips) while 485 trips were made in powered skiffs. Spearfishing and fishing from the 8.5 m catamarans accounted for 165 and 28 trips respectively (SPC Web site). Trolling for pelagic species is the predominant method of fishing used by boats with less effort seen on bottom fishing, drop-lining, and vertical longlining. Shore based fisheries include hook and line, occasional gill netting, reef gleaning, and diving and spearfishing. (Anon. 1999) Shallow-water reef fish stocks on Niue are captured by hook and line and by spearing. (Dalzell *et al*. 1993) Regulations ban the use of underwater breathing apparatus for the purpose of taking or killing fish other than for the taking of any destructive organisms (FFA 2002). Spearfishing is restricted to a few days per year when the sea conditions allow safe access to the reef area, so does not play a major role but may target rarer or larger species or those species that are hard to catch by other methods (Kronen *et al*. 2005).
Northern Mariana Islands	In 1993 there were nine months intensive monitoring of two commercial spearfishing operations: a nighttime scuba operation and a daytime free-diving operation, involving basic descriptors like CPUE, species, composition, and length frequencies. This was followed up about five years later with a similar study (T. Graham, pers. comm., November 2005). Spearfishing is very important in CNMI, but mostly for subsistence/recreational purposes, although there is some commercial activity. Scuba spearfishing has been banned in the entire CNMI, since 2002. Spearfishing by free diving is not considered to have a significant negative effect at this time (M. Trianni, pers. comm., November 2005).

Country or territory	Information on spearfishing
Palau	Although there have been no studies specifically focused on spearfishing in Palau, spearfishing is very important. The modern speargun is used extensively throughout Palau, and are one of the primary means of fishing for commercial markets. Fishing with spearguns, especially at night, has allowed Palauan and other fishers to catch large amounts of fish, including unicornfish, parrotfish, Napoleon wrasses and groupers. The only legislation specifically related to spearfishing is a national ban on spearfishing with scuba. Of relevance to spearfishing, there are several no-take protected areas, in which all fishing is banned, that have been set up specifically to protect the spawning aggregations of groupers. There are also seasonal regulations to protect several species of fish and turtles. Also size restrictions exist for lobsters, turtles and some fish (L. Matthews, pers. comm., November 2005) The history and techniques of day and night spearfishing are described in Johannes (1981).
Papua New Guinea	A survey of subsistence fishing in East New Britain Province in 1999 showed that spearfishing targeted unicornfish, trevally, sweet lips, parrotfish, octopus, mullet, emperors, drummers, and dogtooth tuna. Most of the fish caught from spear fishing are for subsistence consumption and where there is excess, the fish are sold at local markets or restaurants (Gisawa 1999). Two issues important for village spearfishing are: • Kids (5-10 yrs old) in the villages often learn spearfishing first before trying out other methods – as a form of training. These young learning kids have no preference as to the type, size, shape etc. of fish that they spear, and consequently the herbivores and omnivores species within lower trophic level are destroyed. • In some villages men compete to be the best spearfishers in order to earn recognition in a village. This competition increases effort, improves catch efficiency, increases excess catch (as opposed to usual spear fishing for consumption) and drives fish populations down or even away from near shore reefs. Spearfishing using underwater lights at night is even more destructive (L. Gisawa, pers. comm., November 2005).
Tokelau	The regulations on spearfishing vary by island. On Atafu there is a ban on all spearfishing. Nukunonu occasionally bans spearfishing during certain periods. On Fakaofo there are no rules specific to spearfishing, but certain areas of reef are closed to all fishing, either permanently as part of a conservation area or periodically ("lafu") to increase the abundance of fish for communal fishing, usually in advance of a feast (F. Toloa and M. Pelasio, pers. comm., November 2005) The introduction of modern fishing gear has created conservation problems. The virtual absence of pearl oysters in the lagoons has been attributed to diving goggles, unknown in traditional times. Gill nets and spearguns have also presented difficulties with which the traditional system has yet to resolve (Toloa *et al*. 1994).
Vanuatu	In 1990, the number of fishing gear held by the population had doubled since the 1983 agricultural census, reflecting both an increased interest in fishing and a greater availability of fishing equipment in rural retail stores. Fishing lines were by far the most common gear enumerated by the 1991 survey and were used by 94 percent of the 14,041 fishing households enumerated at that time. The second most common gear, hand-spears, were used by 46 percent of households, followed by spearguns (36%), bows and arrows (33%), and gill nets (19%) (Preston 1996). In Vanuatu scuba is not allowed and commercial spearfishing is not yet a major problem. Many villages had protected areas under 3-5 year moratoria which, when opened, were only subject to hand-spearing (ICRI 2000). Regulations ban the spearing of lobster and slipper lobster (FFA 2002) In some Vanuatu villages night spearfishing is taboo for part of the year, in others it is taboo throughout the year (Johannes and Hickey, 2004)

Country or territory	Information on spearfishing
Wallis and Futuna	In Wallis and Futuna there is no fishery data collection but it is well known that spearfishing is an important fishing technique, both in the lagoon and on the outer reef slope. It is presently illegal to spearfish with scuba gear. Regulations are being prepared that would ban taking lobsters with spears as well as night spearfishing (E. Tardy, pers. comm. November 2005).

FAO FishCode Reviews

1 Pintz, W.S. Tuna and bottom fishery licence management: Tonga. *FAO/FishCode Review*. No. 1. Rome, FAO. 2003. 35p.

Fish are now the largest single export from the Kingdom of Tonga. However, expansion of the industry faces severe infrastructure constraints, and granting substantial numbers of new longline licences without resolving the constraints could seriously affect all Tongan commercial fisheries.

2 Gillett, R. Aspects of fisheries management in the Maldives. *FAO/FishCode Review.* No. 2. Rome, FAO. 2003. 61p. (*Restricted distribution)*

The inshore marine resources of the Maldives, an atoll environment, are being increasingly exploited for baitfishing, food for local residents, consumption by tourists, exports and non-extractive uses such as dive tourism. This situation must be reconciled with the limited nature of the resources.

3 Die, D.L.; Alió, J.; Ferreira, L.; Marcano, L.; Soomai, S. Assessment of demersal stocks shared by Trinidad and Tobago and Venezuela. *FAO/FishCode Review*. No. 3. Rome, FAO. 2004. 32pp.

The FAO/WECAFC Workshop on assessment of demersal stocks shared by Trinidad and Tobago and Venezuela (2002) initiated an assessment of the shrimp stocks shared by the two countries. The main conclusion of the assessment is that some shrimp stocks are being severely overfished and are suffering as a result.

4 Gillett, R. The marine fisheries of Cambodia. *FAO/FishCode Review.* No. 4. Rome, FAO. 2004. 57p.

Excess fishing effort and associated declines in abundance of target species are the most serious problems facing Cambodia's marine fisheries: resource sustainability will require restrictions on resource access.

5EN FAO/FishCode. Seminar on responsible fisheries management in large rivers and reservoirs of Latin America. *FAO/FishCode Review*. No. 5. Rome, FAO. 2004. 72p. [En]

This report of the Seminar on Responsible Fisheries Management in Large Rivers and Reservoirs in Latin America (2003), attended by experts from member countries of the Commission, observers from other regional bodies and representatives from local fishing communities in El Salvador, presents the principles of responsible fishery management in Latin America as well as a selection of national reports.

5SP FAO/FishCode. Seminario sobre ordenación pesquera responsable en grandes ríos y embalses de América Latina. *FAO/FishCode Revista.* No. 5. Roma, FAO. 2004. 78 p. [Sp]

El Seminario sobre Ordenación Pesquera Responsable en Grandes Ríos y Embalses de América Latina (2003) se efectuó en San Salvador en asociación con la novena reunión de la Comisión de Pesca Continental para América Latina (COPESCAL). Participaron expertos de países miembros de la Comisión; observadores de otros organismos regionales y representantes de comunidades pesqueras locales de El Salvador. Se presentaron dos documentos sobre los principios de la ordenación pesquera responsable en grandes ríos y embalses en América Latina y una selección de informes nacionales.

6 Swan, J. National Plans to combat illegal, unreported and unregulated fishing: models for coastal and small island developing states. *FAO/FishCode Review.* No. 6. Rome, FAO. 2003. 76p.

These case studies for use in FAO regional and subregional workshops were prepared in accordance with the FAO International Plan of Action to Prevent, Deter and Eliminate IUU Fishing. The "Republic of Galactia" and the "Alpha Islands" are fictitious, but the fisheries profiles presented draw on typical existing circumstances.

7 Kuemlangan, B. Creating legal space for community-based fisheries and customary marine tenure in the Pacific: issues and opportunities. *FAO/FishCode Review.* No. 7. Rome, FAO. 2004. 65p.

The laws of Pacific Island countries generally support traditional fisheries management with only modest efforts to encourage the use of customary marine tenure-based community fisheries management. Government commitment for the role of customary marine tenure in community-based fisheries management, with support from interested stakeholders, will complement efforts for promoting sustainable utilization of fisheries resources and improved livelihoods in the Pacific region.

8 FAO/FishCode. Report of the Workshop on Development of a Management Plan for Tomini Bay Fisheries, Indonesia. *FAO/FishCode Review.* No. 8. Rome, FAO. 2004. 31p.

Tomini Bay fishery resources are still considered to be underexploited, but annual catches have increased dramatically over the past ten years. In the absence of a fisheries management body, The FAO/Government of Indonesia Workshop on the Development of a Management Plan for Tomini Bay Fisheries (2003) provided a starting point for addressing responsible fisheries issues and laying the groundwork for a fisheries management plan

9 FAO/FishCode. Report of the National Conference on Responsible Fisheries in Viet Nam, Hanoi, Viet Nam, 29–30 September 2003. *FAO/FishCode Review.* No. 9. Rome, FAO. 2004. 94p.

This national conference was organized in the context of increasing problems faced by Vietnamese fishers in maintaining and improving their livelihoods through coastal and offshore fisheries; some coastal fish resources in particular are being heavily over-exploited.

10 Stanley, J. Institutional review of the National Fishing Corporation and the Fisheries Department of Tuvalu. *FAO/FishCode Review.* No. 10. Rome, FAO. 2004. 47p. (*Restricted distribution)*

The economic growth and development of Tuvalu depend on its marine resources and especially its relatively rich tuna resources. Although the primary concern of the government is the sustainable economic development and management of tuna, there is also potential for the development of other marine products, particularly deep bottom fish.

11 García Mesinas, A. Lineamientos para un Código de Ética de Pesca y Acuicultura para El Salvador. *FAO/FishCode Revista.* No. 11. Roma, FAO. 2004. 59p. [Sp] (*Restricted distribution)*

Este documento presenta los resultados de un proyecto llevado a cabo a través del Programa FishCode de la FAO a petición del Gobierno de El Salvador para desarrollar los lineamientos a nivel nacional del Código de Ética de la Pesca y Acuicultura. El trabajo se realizó coordinado a través de la Oficina Regional de América Latina (RLC) y la Representación de FAO de El Salvador.

12 FAO/FishCode. Report of the National Workshop on the Code of Conduct for Responsible Fisheries and its practical application to coastal aquaculture development in Viet Nam. *FAO/FishCode Review.* No. 12. Rome, FAO. 2004. 47p.

The National Workshop on the Code of Conduct for Responsible Fisheries and its Practical Application to Coastal Aquaculture Development in Viet Nam took place in Hué from 3 to 4 October 2003. The Workshop aimed to build awareness among national and provincial stakeholders about the need to develop and implement an Aquaculture Code of Conduct for Viet Nam. Coastal aquaculture in Viet Nam, particularly shrimp culture, has developed rapidly in recent years. Although shrimp farming has brought many benefits to coastal communities, it is associated with high social and environmental risks.

13 FAO/FishCode. Report of the National Seminar on the reduction and management of commercial fishing capacity in Thailand. *FAO/FishCode Review.* No. 13. Rome, FAO. 2005. 59p.

The marine capture fisheries sector is more capital intensive than is appropriate for Thailand's resource endowment, and there is an urgent need for fishing capacity reduction for improved fisheries management and protection and conservation of fish habitats and other threatened coastal resources. Failure to achieve this will have serious consequences for the most vulnerable people in coastal communities, fish consumers and society at large.

14 FAO/FishCode. Reports of the regional vessel monitoring systems workshops: Southwest Indian Ocean, Central America, the Caribbean and Southeast Asia *FAO/FishCode Review.* No. 14. Rome, FAO. 2005. 91p.

Four regional workshops on vessel monitoring systems (VMS), respectively covering the South West Indian Ocean, Central America, the Caribbean and Southeast Asia, were organized and implemented in succession from September 2003 to October 2004. The workshops were intended to promote the use of VMS as an additional instrument for the management of fisheries, both at a national level and in cooperation with regional fisheries bodies. They comprise one aspect of FAO's larger set of activities to implement the International Plan of Action (IPOA) to Prevent Deter or Eliminate Illegal, Unreported and Unregulated (IUU) Fishing. The document includes a CD-ROM.

15 FAO/FishCode. Fishery policy in the Marshall Islands. *FAO/FishCode Review.* No. 15. Rome, FAO. 2005. 33p.

Fisheries play a key role in the economy of the Republic of the Marshall Islands (RMI) and in the lives of its people. Substantial tuna resources are exploited from the country's vast exclusive economic zone, largely by foreign fishing vessels operating under licence. Coastal fisheries are important for subsistence purposes, and also generate income for atoll communities. RMI's well-recognized remote and pristine outer atoll lagoons are considered suitable for targeted commercial mariculture development. The Marshall Islands Marine Resources Authority is investing heavily in formulating its outer island work programmes, involving both coastal fisheries and mariculture research and development. A cautious and transparent approach is needed, with attention to partnerships between communities and private business concerns and the use of incentives involving seed funding, technical assistance, transport facilitation, and other support activities.

16 FAO/FishCode. Report of the Conference on the National Strategy for Marine Fisheries Management and Development in Viet Nam. *FAO/FishCode Review.* No. 16. Rome, FAO. 2005. 64p.

The Conference on the Strategy for Marine Fisheries Management and Development in Viet Nam, (Hanoi, 26 – 27 April 2005) was organized by the Ministry of Fisheries of Viet Nam (MOFI) in close collaboration with the Research Institute Marine Fisheries, the DANIDA Fisheries Sector Programme Support (FSPS) and the FAO FishCode Programme. It represented the culmination of a process that started in 2003 with the Conference on Responsible Fisheries in Viet Nam and that included a number of local level consultations as well as a senior expert meeting in 2004. The 2005 Strategy Conference was attended by a wide range of sectoral stakeholders, representing local and commercial fisheries interests, national and provincial government bodies, bilateral development assistance agencies and international organizations. Observations and recommendations received from the Conference have provided a basis for MOFI to fi nalize the Strategy for official Government approval.

17 Macfadyen, G.; Cacaud, P.; Kuemlangan, B. Policy and legislative frameworks for co-management. Paper prepared for the APFIC Regional Workshop on Mainstreaming Fisheries Co-management in Asia Pacific. Siem Reap, Cambodia, 9–12 August 2005. *FAO/FishCode Review.* No. 17. Rome, FAO. 2005. 51p.

This paper was prepared for the Asia-Pacific Fisheries Commission workshop on mainstreaming fisheries co-management, held in Cambodia in August 2005. It examines the policy and legislative frameworks for co-management in thirteen countries in Asia and the Pacific, and the extent to which these frameworks hinder or support co-management practices. The nature of policy and legislative frameworks is varied, as is commitment by governments to co-management – in some cases support is more rhetoric than reality, with insufficient real transfer of powers and financial resources to local levels. Through an analysis of the different case studies, “lessons learned” are presented and a number of conclusions drawn about the key characteristics of a supportive policy and legislative frameworks based on some ideas about “best practice”. The adoption of these characteristics by governments would demonstrate their commitment to co-management and increase the likelihood of co-management success.

18 Report of the Global Fisheries Enforcement Training Workshop, Kuala Lumpur, Malaysia, 18–22 July 2005 – in preparation.

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fishCODE

The FAO Programme of Global Partnerships for Implementation of the Code of Conduct for Responsible Fisheries

Spearfishing is growing in importance in the Pacific Islands. While its management has featured as a topic in some regional-level meetings, detailed information on spearfishing is surprisingly scarce. In early 1994, the Secretariat of the Pacific Community (SPC) proposed to consolidate information on spearfishing in the Pacific Islands. The original intent was to undertake a review of the available literature through a desk study. With the realization that many issues related to spearfishing are undocumented, the strategy was changed to include some field work. These activities were supported by the FAO FishCode Programme.
This report reviews spearfishing in selected Pacific Island countries and identifies the important species caught by and the major problems associated with the method. It further considers possible interventions to mitigate these problems and the assistance that is likely to be required by Pacific Island countries in the management of their spearfisheries. For several reasons, a complete ban of scuba spearfishing coupled with effective enforcement is the single most important spearfishing management measure.

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