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Marine fishery resources of the Pacific Islands

Cover photograph:
Diving for giant clams in Tokelau (courtesy of Daphne Hougard).

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by

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Preparation of this document

The FAO Marine and Inland Fisheries Service (FIRF) is responsible for all programmes and activities of the Food and Agriculture Organization of the United Nations related to management and conservation of fishery resources. This document was prepared as part of the work programme of FIRF and is intended to be a contribution to the understanding of the marine fishery resources of the Pacific Islands region.

This technical paper was prepared by Robert Gillett, a fisheries specialist based in Fiji, under the direction of Jacek Majkowski (FIRF).

Abstract

This document updates and expands an earlier review by FAO of the marine fishery resources of the Pacific Islands (Gillett, 2005a). The Pacific Islands region consists of 14 independent countries and 8 territories located in the western and central Pacific Ocean. In this area, there are about 200 high islands and some 2 500 low islands and atolls.

The main categories of marine fishing in the area are:

- *Offshore (oceanic) fishing.* This type of fishing is undertaken mainly by large, industrial-scale fishing vessels. Approximately 1 500 of these vessels operate in the exclusive economic zones (EEZs) of Pacific Island countries, mainly using purse-seine, longline and pole-and-line gear to catch tuna.
- *Coastal fishing*. This type of fishing can be divided into three categories: (1) small-scale commercial fishing (also referred to as "artisanal"), which can be further broadly subdivided into those operations supplying domestic markets and those operations producing export commodities; (2) subsistence fisheries, which support rural economies and are extremely important to the region's nutrition and food security; and (3) the industrial-scale shrimp fisheries, which in the region only occur in Papua New Guinea.

The region's fishery resources can be broadly split into two main categories: oceanic (offshore) and coastal (inshore). Oceanic or offshore resources include tunas, billfish and allied species. They are characterized by an open-water pelagic habitat and potentially extensive individual movements. Coastal or inshore resources include a wide range of finfish and invertebrates. They are characterized by their shallow-water habitats or demersal life-styles, and restriction of individual movements to coastal areas. This paper discusses these two resource categories. Information is provided on the major types of fishing, the important species, the status of those resources and the fisheries management that occurs.

In general, the coastal fishery resources are heavily fished and often show signs of overexploitation, especially in areas close to population centres and for fishery products in demand by the rapidly-growing Asian economies. With respect to the status of oceanic fishery resources, it is clear that there is most concern with bigeye. By contrast, the skipjack resource is in relatively good condition, with the large, recent catches considered to be sustainable.

Gillett, R.
Marine fishery resources of the Pacific Islands.
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Acronyms and abbreviations

ADB	Asian Development Bank
CCM	Conservation and management measure
CITES	Convention on International Trade in Endangered Species
DWFN	Distant water fishing nation
EAFM	Ecosystem approach to fisheries management
EEZ	Exclusive economic zone
FAD	Fish aggregation device
FAO	Food and Agriculture Organization of the United Nations
FFA	Forum Fisheries Agency
FSM	Federated States of Micronesia
GDP	Gross domestic product
MPA	Marine protected area
MSY	Maximum sustainable yield
MTCs	Minimum terms and conditions (of access)
NGO	Non-governmental organization
OFP	Oceanic Fisheries Programme (of the Secretariat of the Pacific Community)
PIMRIS	Pacific Islands Marine Resources Information System
PNG	Papua New Guinea
ProcFish-C	Pacific Regional Oceanic and Coastal Fisheries Project
SOPAC	South Pacific Applied Geoscience Commission
SPC	Secretariat of the Pacific Community (formerly South Pacific Commission)
SPREP	South Pacific Regional Environment Programme
TMP	Tuna Management Plan
UNCLOS	United Nations Conference on the Law of the Sea
US	United States (of the United States of America)
VMS	Vessel monitoring system
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean

Introduction

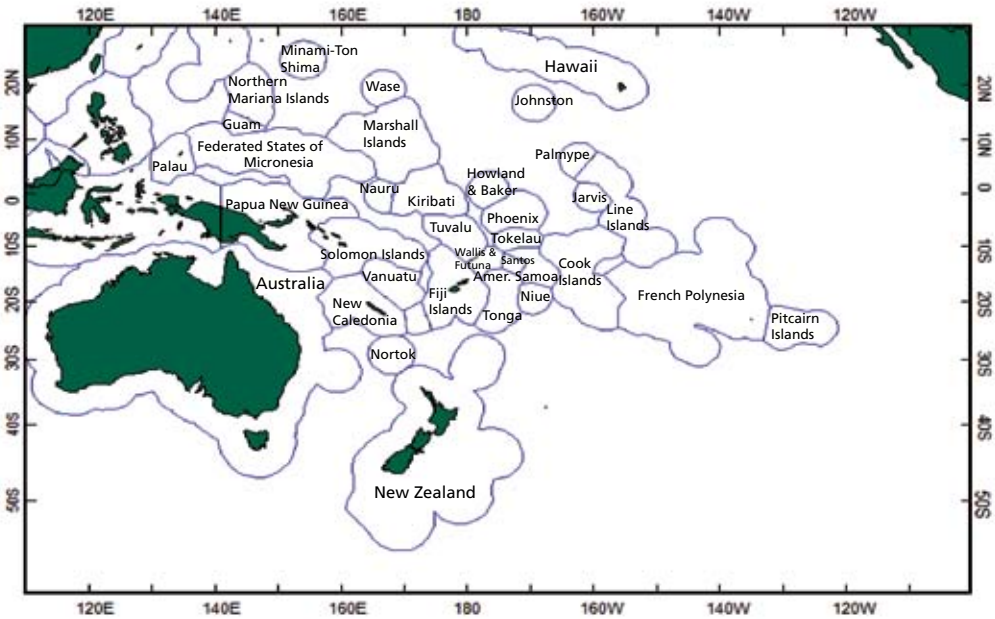
In the Pacific Islands region fishery resources are critically important as a source of food and employment, a generator of government revenue and a foundation for economic development. A knowledge of these fishery resources is required for an understanding of many aspects of the countries of the region, including their economies, nutrition, political relationships and development aspirations.

Since the late 1950s, the Food and Agriculture Organization of the United Nations (FAO) has been involved in various fisheries activities in the region, including reviewing the fishery resources. This document updates and expands an earlier review by FAO of the marine fishery resources of the Pacific Islands (Gillett, 2005c).

1. The Pacific Islands region

The Pacific Islands region consists of 14 independent countries and 8 territories located in the western and central Pacific Ocean. There is also a substantial amount of international waters (high seas) in the area. Figure 1 shows these countries and territories, their 200-mile zones and the international waters, and Table 1 gives summary details on the countries and territories.

FIGURE 1
Countries and territories and their EEZs in the Pacific Islands region



Source: Courtesy of the Secretariat of the Pacific Community (SPC).

The Pacific Islands region contains about 200 high islands and about 2 500 low islands and atolls. Apart from the Pitcairn group and the southern part of French Polynesia in the east of the area, all the islands of the area lie in the tropical zone.

In general, the islands increase in size from east to west, with Papua New Guinea at the western-most edge of the region having most of the region's land area. The islands mostly rise steeply from the deep ocean floor and have very little underwater shelf. Coral reefs characteristically surround the islands, either close to the shore (fringing reef) or further offshore (barrier reef), in which case a coastal lagoon is enclosed. The area includes many atolls, which are the remnant barrier reefs of islands that have subsided. Some of the more recent islands in the area lack

coral reefs. Mangrove forests often border the inshore waters, especially of the larger islands, and provide habitat for the juveniles of many important food fish.

TABLE 1
Land area, area of 200-mile zones and population of 22 Pacific Island countries and territories[1]

	Country/territory	Land area (km²)	Area of 200-mile zone (km²)	Estimated population[2] (July 2007)
Independent Pacific Island countries	Cook Islands	180	1 830 000	15 473
	Federated States of Micronesia	702	2 978 000	109 999
	Fiji	18 376	1 290 000	834 278
	Kiribati	726	3 550 000	93 707
	Marshall Islands	720	2 131 000	52 701
	Nauru	21	320 000	9 930
	Niue	258	390 000	1 587
	Palau	500	629 000	20 162
	Papua New Guinea	461 690	3 120 000	6 332 751
	Samoa	2 934	120 000	179 478
	Solomon Islands	29 785	1 340 000	503 918
	Tonga	696	700 000	102 264
	Tuvalu	26	900 000	9 701
	Vanuatu	12 189	680 000	227 146
Pacific Island territories	American Samoa	197	390 000	65 029
	French Polynesia	3 521	5 030 000	260 072
	Guam	549	218 000	173 995
	New Caledonia	19 103	1 740 000	242 561
	Northern Marianas	475	1 823 000	64 050
	Pitcairn Islands	5	800 000	54
	Tokelau	12	290 000	1 170
	Wallis and Futuna	124	300 000	15 369

Source: Gillett and Preston (1997) and SPC (2008b).

Because of the relatively small size of most islands, major bodies of fresh water are not widespread in the region, with substantial rivers and lakes only being found in some of the larger islands of Melanesia. The small land areas of most islands create limited freshwater and nutrient runoff, resulting in low enrichment of the nearby sea. The ocean waters of the region are usually clear and low in productivity. Upwelling occurs in the boundaries between currents and in other localized areas, and has important implications for the harvesting of marine resources.

The dispersed nature of the region's land among this vast area of water has several consequences for fisheries management. In regard to coastal resources, the presence of numerous patches of land and their associated coastal and coral reef areas, separated by large distances and sometimes abyssal depths, means that many species with limited larval dispersal can be effectively managed as unit stocks. On

[1] Unless otherwise stated, the remainder of this technical paper deals with the fishery resources and associated fisheries of the independent Pacific Island countries.

[2] From SPC, 2008.

the contrary, management of shared stocks of highly migratory species such as tunas can only be effective if carried out on a multicountry basis. The presence of extensive areas of international waters among the region's exclusive economic zones (EEZs) greatly complicates the region's fishery management efforts.

The Pacific Island countries have two regional organizations with major involvement in fisheries. At least some knowledge of those organizations is a prerequisite to appreciating the management of fisheries of the area (Box 1).

BOX 1

Fisheries and the regional organizations in the Pacific Islands

Compared to other fishing regions of the world, an important feature of the Pacific Islands area is the strong regional organizations active in the fisheries sector. The two main organizations are:

- **The Secretariat of the Pacific Community (SPC).** SPC, based in Noumea, New Caledonia, helps its member countries and territories in matters relating to (a) coastal fisheries development and management and (b) scientific research and catch data compilation on the tuna resources of the region.
- **The Forum Fisheries Agency (FFA).** FFA, based in Honiara, the Solomon Islands, assists its member countries in matters dealing with the management of the region's tuna resources, including economics, surveillance and legal aspects.

Other regional organizations also have responsibilities in fisheries. These are the South Pacific Regional Environment Programme (SPREP), based in Apia, Samoa, the South Pacific Applied Geoscience Commission (SOPAC), in Suva, Fiji, and the University of the South Pacific in Suva, Fiji.

2. Fishery statistics in the region

With respect to the quality and coverage of statistics, there are major differences between the region's coastal fishery statistical system and the oceanic (offshore) fishery statistical system. The following information, taken largely from two studies that review the fishery statistics in the region (FAO, 2001; Gillett and van Santen, 2008) summarizes the situation.

COASTAL FISHERY STATISTICS

For coastal fisheries, the quality of fishery statistics furnished to FAO by national governments is generally not very good. In fact, the estimation of the production of coastal fisheries by government fishery officers in about half of the Pacific Island countries is largely guesswork. Typically, government fisheries agencies give low priority to estimating the amount of coastal catches. In general, the smaller the scale of the fishing, the less is known about the production levels, with quantitative information being especially scarce for the subsistence fisheries in most countries.

Short-term support to enhance fishery statistical systems has been provided by FAO, SPC and several bilateral agencies. Typically, once external support is withdrawn, the statistical systems usually degenerate and eventually become dysfunctional. Despite the importance of data on coastal fisheries, the reality is that in the prioritization of scarce government funding, the ongoing routine collection of fisheries data has not received much priority.

Although most of the countries in the region attach great important to their subsistence and small-scale commercial fisheries, it is these fisheries that present the greatest difficulties for the collection of production information. A further consideration is that many fishery specialists have questioned the cost-effectiveness and practicalities of regular data collection by small-scale fisheries in Pacific Island countries.

Attention is now being focused on the collection of fishery production information using surveys outside the fisheries sector. Many fishery specialists in the region support the concept that well conducted household income and expenditure surveys and censuses can provide basic information on the composition, quantity and estimated value of coastal fisheries.

OFFSHORE FISHERY STATISTICS

The situation of offshore fishery statistics is considerably different. The offshore statistical systems are in relatively good condition, both at a national and regional level. As a component of the SPC fishery services to the region, the Oceanic Fisheries Programme (OFP) has a Statistics and Monitoring Section. The activities

of that section currently include the compilation of estimates of annual catches of target tuna and billfish species, the estimation of annual catches of non-target species, the compilation of operational (logsheet) catch and effort data, data processing on behalf of member countries and territories, the provision of technical support for port sampling programmes and observer programmes in member countries and territories, training in fishery statistics and database management, the development of data collection forms, the publication of the Western and Central Pacific Tuna Bulletin and the *WCPFC Tuna Fishery Yearbook*, statistical analyses and the provision of statistical support to other regional and international organizations involved in the fisheries of the region.

3. Main categories of fisheries in the region

Fishing activity in the Pacific Islands can be classified both by area in which the fishing is undertaken and by scale. Although the terminology used is not standardized across the region[3], one system of classification is as follows.

OFFSHORE FISHERIES

Offshore fishing is undertaken mainly by large industrial-scale fishing vessels[4]. Approximately 1 500 of these vessels operate in the EEZs of Pacific Island countries and the main gear used to catch tuna are the purse seine, longline and pole-and-line. A fourth type of gear is trolling line, but tuna fishing with trolling line is not undertaken on an industrial scale in the Pacific Islands, although some industrial tuna trollers are based in the region and troll in temperate waters to the south. The amount of tuna captured by offshore vessels in the region is many times greater than the catch from coastal fisheries. Offshore fishing in the region can be further subdivided into two categories as follows.

- **Locally-based offshore fishing.** A survey carried out in 2008 (Gillett, 2008a) showed that 269 longline vessels, 56 purse-seine vessels and 2 pole-and-line vessels were based in the region. About 1 169 people from the Pacific Islands are employed on these tuna vessels.
- **Foreign-based offshore fishing.** Approximately 1 200 foreign-based vessels operate in the waters of Pacific Island countries. Although about 65 percent of the vessels are longliners, about three-quarters of the tuna catch is taken by purse seiners. Most foreign fishing vessels are based in Asia, while some United States-flagged purse-seine vessels are based in American Samoa. The licence fees paid to Pacific Island countries by these foreign-based vessels is substantial and in some cases the major source of government revenue for some countries.

COASTAL FISHERIES

Coastal fishing is of fundamental importance in the Pacific Islands. Much of the region's nutrition, welfare, culture, employment and recreation are based on the living resources in the zone between the shoreline and the outer reefs. The

[3] A lengthy discussion of classifying fisheries in the region is presented in Gillett, 2005c.

[4] The term "industrial fishing vessel" is often used in the region and is loosely understood to mean large vessels that operate offshore. A more encompassing and robust definition could be formulated in detail, but for the purpose of this short paper, an industrial fishing vessel is defined as a fishing craft that is generally greater than 15 metres in length.

continuation of current lifestyles, the opportunities for future development and food security are all highly dependent on coastal fishery resources. Although dwarfed in both volume and value by the offshore tuna fisheries, the Pacific Island fisheries that are based on coastal resources provide most of the non-imported fish supplies to the region. Coastal fisheries harvest a very diverse range of finfish, invertebrates and algae. Unlike the tuna fishery, virtually all coastal catch is taken by Pacific Islanders themselves, with very little access by foreign fishing vessels. Coastal fishing in the region can be placed in three categories as follows.

- **Small-scale commercial fishing** (also referred to as "artisanal"). This category can be further broadly subdivided into operations supplying domestic markets and operations producing export commodities.
- **Subsistence fisheries.** They support rural economies and are extremely important to the region's nutrition and food security.
- **Industrial-scale shrimp fisheries.** In the region, they only occur in Papua New Guinea.

In 2008, the Asian Development Bank (ADB) estimated the fishery production in each Pacific Island country. All readily available sources of production information for each country were scrutinized to come up with a best estimate of national catches in four of the fishery categories (Table 2).

TABLE 2
Marine fisheries production in Pacific Island countries, 2007 (tonnes)

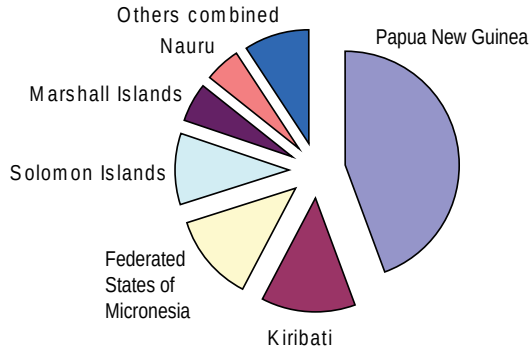
Country	Coastal commercial fishing	Coastal subsistence fishing	Offshore locally-based fishing	Offshore foreign-based fishing	Total (tonnes)
Papua New Guinea	5 700	30 000	256 397	327 471	619 568
Kiribati	7 000	13 700	0	163 215	183 915
Federated States of Micronesia	2 800	9 800	16 222	143 315	172 137
Solomon Islands	3 250	15 000	23 619	98 023	139 892
Marshall Islands	950	2 800	63 569	12 727	80 046
Nauru	200	450	0	69 236	69 886
Fiji	9 500	17 400	13 744	492	41 136
Tuvalu	226	989	0	35 541	36 756
Vanuatu	538	2 830	0	12 858	16 226
Samoa	4 129	4 495	3 755	25	12 404
Tonga	3 700	2 800	1 119	0	7 619
Palau	865	1 250	3 030	1 464	6 609
Cook Islands	133	267	3 939	0	4 339
Niue	10	140	640	0	790

Source: ADB, 2009.

The results are shown graphically in Figure 2. The six countries that have the most production have large tuna fisheries and, with the exception of Papua New Guinea, most of the tuna catch in those countries is taken by foreign-based vessels. Other notable features of the information in Table 2 are:

- the general pattern of decreasing total national catches going from west to east across the region and from equatorial to higher latitudes;
- the relatively large contribution of offshore locally-based production in the Marshall Islands and to a lesser extent Fiji; and
- the relatively large contribution of non-tuna production in Fiji.

FIGURE 2
Marine fisheries production by volume and major producing countries, 2007



Source: Based on Table 2 above.

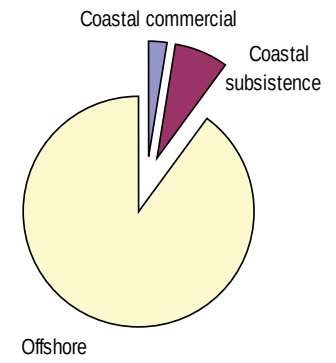
Figure 3 below shows that the production from the offshore fisheries[5] is about nine times greater than the coastal fisheries production (commercial and subsistence). It is easy to conclude that offshore fishing and the tuna resources upon which fishing is based, are very important to the region.

With respect to catch value, the ADB study determined that the unit price across the region equates to:

- US$3.70 per kg: coastal commercial production
- US$1.82 per kg: coastal subsistence production
- US$1.49 per kg: offshore locally-based production
- US$1.26 per kg: offshore foreign-based production

The very high unit value of coastal commercial production is due to high prices paid for invertebrate species (e.g. beche-de-mer, aquarium fish). The high unit value of offshore locally-based production relative to offshore foreign-based production reflects a larger proportion of high sashimi production and a lower proportion of cannery-grade tuna production.

FIGURE 3
Marine fisheries production by volume and fishery category, 2007



Source: Modified from Table 2 above.

[5] In Figure 3, a single category "offshore" represents the combined categories of "offshore locally-based fishing" and "offshore foreign-based fishing" appearing in Table 2. The catch figures in the "offshore" category have been adjusted whereas in Table 2 they are double counted – the catch of a Pacific Island fleet in the zone of another Pacific Island country is counted both as "offshore locally-based" in the home country of the fleet and as "offshore foreign-based" in the country where the catch is made.

4. Coastal fishery resources

The region's marine fishery resources can be broadly split into two main categories: coastal (or inshore) and oceanic (or offshore). Coastal resources will be discussed in this chapter, while chapter 5 deals with offshore resources. Coastal resources include a wide range of finfish and invertebrates. These resources are characterized by a shallow-water habitat or demersal lifestyle, restriction of individual movements to coastal areas and in most cases, more restricted larval dispersal. Because of their relative accessibility, these resources form the basis of most of the region's small-scale fisheries.

SOURCES OF INFORMATION ON COASTAL FISHERY RESOURCES

Information on coastal fishery resources of the Pacific Islands is available from a variety of sources at both the national and regional levels. The regional overview documents that have proven to be most useful are:

- The book entitled *Nearshore Marine Resources of the South Pacific. Information for Fisheries Development and Management* (Wright and Hill, 1993) is somewhat dated, but nevertheless extremely useful. The publication contains chapters on the 17 most important groups of coastal marine resources: shallow-water finfish, trochus, marine aquarium fish, etc. Each chapter covers biology, resource assessment, fisheries description, management concerns and references.
- In the early 1990s, the Forum Fisheries Agency (FFA) produced fisheries resource profiles for most of the Pacific Island countries. Each national profile has a section on each of the important fisheries resources. Each section discusses the resource, the fishery, stock status and management, and has a list of references. For example, the *Fiji Fisheries Resources Profiles* (Richards, 1994) covers 37 groups of fisheries resources (e.g. emperors, small pelagics, giant clams) in 235 pages.
- The *FAO Species Identification Guide for Fishery Purposes: the Living Marine Resources of Western Central Pacific* (Carpenter and Niem, 1998) consists of six volumes and 4 218 pages. The series covers virtually all marine resources of economic value, including such groups as seaweed, coral and holothurians. In addition to taxonomic information on each species, the guide gives information on habitat, biology, fisheries and distribution.
- SPC produces a series of fishery information bulletins, including several bulletins focused on coastal resources of special interest such as beche-de-mer (28 bulletins issued since January 1990), trochus (14 bulletins since July 1992) and pearl oyster (18 bulletins since February 1990).

- Various development partners have undertaken regional studies of specific fishery resources. These include the ADB study on the fish of the live reef food fish trade, the World Bank study on trochus, the FAO study on beche-de-mer and the WorldFish Center study on giant clams.

Many studies on specific coastal fishery resources have been carried out at the national level over the years in all of the countries of the region. Examples are studies on mullet in Tonga, tuna baitfish in Kiribati, trochus in the Marshall Islands, coconut crabs in Niue, shrimps in Papua New Guinea, aquarium fish in Palau and coral in Fiji. The reports on these studies, especially the older ones, are frequently not readily available. Often, there is not even an awareness that the studies were conducted, sometimes leading to duplicate research.

Pacific Islands Marine Resources Information System (PIMRIS) is a formal cooperative network of libraries and information centres within the Pacific Islands regional organizations and government agencies concerned with the development of fishery and marine resources. Its aim is to improve access to information on marine resources in the region by collecting, cataloguing, preserving and disseminating relevant documents in print and electronic formats, especially "grey literature". The PIMRIS coordination unit, located at the University of the South Pacific, and the cooperating Information Section at SPC, are important sources of documents on coastal fishery resources of the Pacific Islands. Those agencies often hold reports of the studies mentioned in the previous paragraph – even those reports not available at the national level.

SPC has a wealth of information on the coastal fishery resources of the Pacific Islands. This information includes reports on projects it has carried out (e.g. beche-de-mer, lobster, deep-water bottom fish, aquarium fish), documentation accumulated over the previous 50 years, staff expertise and data generated by the recently completed Pacific Regional Oceanic and Coastal Fisheries Project (ProcFish-C). The coastal component of the ProcFish-C is aimed at providing Pacific Island governments and communities with accurate, unbiased scientific information about the status and prospects of reef fisheries, with an emphasis on the identification of specific indicators that can be used for long-term monitoring of the status of reef fisheries.

IMPORTANT COASTAL FISHERY RESOURCES

The important coastal fishery resources of the region can be categorized in a number of ways. On a broad level, some schemes classify by type of fisher (subsistence, commercial) and other schemes classify by the fate of the catch (local use, export) or taxonomic group (finfish, invertebrates and others). The most appropriate scheme depends on the objective for classifying, i.e. whether for economic or biological reasons. For the purpose of the present report, resources are classified by taxonomic group, e.g. finfish, invertebrates and others.

Finfish

Dalzell and Schug (2002) review finfish that are important in Pacific Island coastal fisheries. They state that a typical small-scale commercial reef fishery in the western and central areas of the region may harvest between 200 and 300 finfish species, although it is likely that only a few species will dominate landings. Table 3 is a composite "average" of landings from 15 locations in the Pacific Islands region.

Approximately one-third of the coastal catch total is comprised of emperors (Lethrinidae), surgeonfish (Acanthuridae) and snappers (Lutjanidae).

Invertebrates

The invertebrates of fishery importance in the region can be divided into two groups, the invertebrates for local food and the invertebrates for export.

- SPC (2008c) gives the 14 most-landed invertebrate food species groups in the region (wet weigh) as gleaned from questionnaire surveys: giant clams (about 40 percent of the total) and beche-de-mer (about 5 percent of the total), followed by much smaller amounts of crabs, lobsters, strombus, turbo, arc shell, other bivalves/gastropods, trochus, urchin, octopus, shoreline gastropods, beach bivalves and land crabs.

TABLE 3
Composition of a reef and lagoon fishery – Landings from 15 locations in the Pacific Islands region

Scientific name	Common name	Percent
Lethrinidae	Emperors	13.32
Acanthuride	Surgeonfish	10.91
Lutjanidae	Snappers	9.19
Carangidae	Jacks/scads	7.19
Serranidiae	Groupers	6.96
Mugilidae	Mullets	6.90
Scaridae	Parrotfish	6.58
Scombridae	Tuna/mackerels	5.53
Mullidae	Goatfish	3.25
Siganidae	Rabbitfish	2.92
Holocentridae	Soldierfish/squirrelfish	2.69
Sphyraenidae	Barraccudas	1.53
Albulidae	Bonefish	1.36
Haemulidaei	Grunts	0.89
Belonidae	Needlefish	0.81
Balistidae	Triggerfish	0.74
Labridae	Wrasses	0.52
Gerridae	Mojarras	0.49
Hemiramphidae	Garfish	0.17
Chanidae	Milkfish	0.15
Theraponidae	Surf perches	0.03
Others		17.87

Source: Dalzell and Schug, 2002.

- Export invertebrates have historically been beche-de-mer, trochus and pearl oysters. In recent years, there has been considerable export of live molluscs, crustaceans and corals for the aquarium industry. The export of penaeid shrimp is significant, but export only from Papua New Guinea.

Other important coastal fishery resources

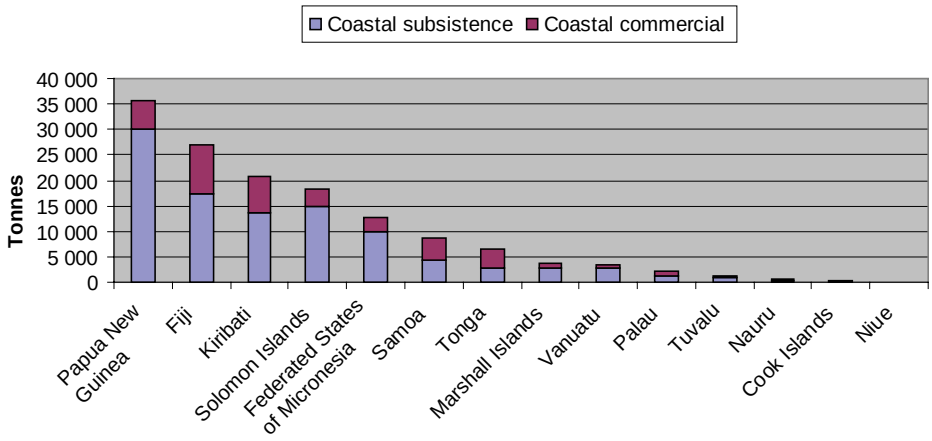
Seaweeds are considered a "fishery" resource in most Pacific Island countries. They are mainly used for local food but exported from a few countries (e.g. Tonga). In the *Fiji Fisheries Resources Profiles* (Richards, 1994), mangroves are included as a coastal fishery resource. "Live rock", which is a portion of reef rock covered with attached organisms, particularly coralline algae, is considered a fishery resource in several Pacific Island countries. (Lovell, 2000).

IMPORTANT TYPES OF COASTAL FISHING

Table 2 above gives estimates of fisheries production for each Pacific Island country in 2007. Figure 4 takes the coastal fishing data from Table 2 and shows graphically the 2007 production by country.

The figure shows that in most countries of the region, the volume of production from coastal subsistence fisheries is many times greater than that of coastal commercial fishing, with Tonga and Samoa being notable exceptions.

FIGURE 4
Coastal fisheries production by country, 2007 (tonnes)



Source: Based on Table 2 above.

Subsistence fishing

As can be seen from Table 2 above, about 70 percent of the overall fisheries production from coastal areas of the Pacific Islands is produced by subsistence fishing. In several countries, namely Tuvalu, the Solomon Islands, Vanuatu, Papua New Guinea and Niue, over 80 percent of the coastal catch is from the subsistence sector.

In a recent review of benefits from Pacific Island fisheries, ADB (2009) estimated that the contribution of subsistence fishing to gross domestic product (GDP) was actually quite significant in a number of Pacific Island countries. Overall, about 30 percent of the GDP contribution from the fisheries sector in the region comes from subsistence fishing.

Subsistence fisheries generally take a large variety of species, including fish, molluscs, crustaceans, algae and other groups. For example, Zann (1992) reports that in Western Samoa the subsistence fisheries make use of 500 species. In a study of coastal resources management in the Pacific Islands (World Bank, 2000), residents in coastal villages in five countries identified what they considered were their major coastal resources (Table 4).

TABLE 4
Resources that support subsistence fishing

Country	Groups of fishery resources (descending order of importance)
Fiji	Finfish, beche-de-mer, octopus, seaweed, lobster, mud crab and various bivalve molluscs
Tonga	Finfish, octopus, lobster, beche-de-mer, turbo, giant clams, seaweed and Anadara
Samoa	Finfish (especially surgeonfish, grouper, mullet, carangids, rabbitfish), octopus, giant clams, beche-de-mer, turbo and crab
Solomon Islands	Finfish, beche-de-mer, trochus, giant clam, lobster, turbo and mangroves
Palau	Finfish, giant clams, mangrove crab, lobster, turtle and beche-de-mer

Source: World Bank, 2000.

Subsistence fishing tends to be most important in rural areas, but as rural economies become increasingly monetized, the amount of fish being traded for cash grows and there is a gradual move away from fishing for home consumption or to meet social obligations and towards fishing as a means of generating cash income.

Much of the subsistence fishing in the region either does not involve a vessel (i.e. gleaning from shore, or swimming) or uses a non-powered canoe. Typical characteristics of subsistence fisheries in the Pacific Islands are: specialized knowledge often passed down through generations, labour-intensive operations sometimes involving the entire community, sharing of the catch among the community, social restrictions/prohibitions and specialization of activity by gender.

Characteristically, women are involved in inshore fishing activities, such as reef gleaning and invertebrate collection, and the preparation of food from the products of fishing activities. Men are usually involved in the more strenuous work of fishing further offshore for large species of fish, and in diving activities. There are, however, important exceptions to this generalization. Several observers of the situation of the Pacific Island subsistence fisheries estimate that fishing activity by women actually results in a greater amount of family food than fishing activity by men.

Although several development projects have attempted to commercialize aspects of fishing in subsistence communities, they have usually met with limited

success. An FAO study (Carleton, 1983) of the fish marketing situation in many Pacific Island countries concluded: "the basic structure of the subsistence sector is not conducive to the regular supply of fish to urban communities in sufficient quantities to satisfy demand". This is still true today.

Coastal commercial fishing

Compared to the subsistence fisheries of the region, the coastal commercial fisheries are smaller and take a more restricted range of species, although the number of different species may still be substantial. For example, over 100 species of finfish and 50 species of invertebrates are included in Fiji's fish market statistics. Total commercial fishery products from the region include reef and deep-slope fish (about 43 percent of total weight), coastal pelagic fish (18 percent of total weight), shell products (trochus, green snail and pearl shell, 9 percent of total weight), crustaceans (8 percent of total weight), beche-de-mer (7 percent of total weight) and estuarine fish (6 percent of total weight).

It may not be appropriate to place the various types of coastal commercial fishing into discrete "fisheries", especially for the smaller-scale fishing. A single fishing trip often involves the use of several types of gear to make a range of catches. For example, Gillett and Moy (2006) state that during a multiday fishing trip, spearfishers in Fiji characteristically collect beche-de-mer, trochus and lobster and do some handlining in addition to the main effort of spearing finfish. Therefore, it is more suitable to discuss the various types of coastal commercial fishing in the region by primary target.

Shallow-water reef fish

Around most of the Pacific Islands, finfish found in relatively shallow water (<50 m) are the basis of much commercial fishing. About 300 species representing 30 to 50 fish families comprise the majority of the catch. The main gears are handlines, spears and gillnets. Dalzell and Schug (2002) give the yields for the common types of gear used in the region for shallow-water reef fish (Table 5). Commercial export of shallow-water reef fish is not a major activity; the vast majority of the catch is for the domestic urban market.

TABLE 5
Yields for shallow-water reef fishing

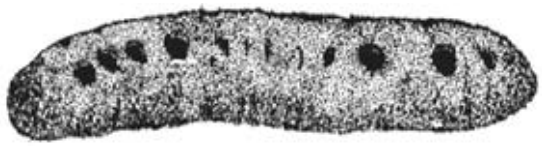
Fishing method	Catch rate units	Catch rate range	Catch rate mean
Handline	kg/line-hour	0.40–3.50	1.90
Spearfishing	kg/man-hour	0.41–8.5	2.97
Gillnet	kg/set	3.0–39.0	15.79
Drive-in net	kg/set	14–350	80.90

Source: Dalzell and Schug, 2002.

Beche-de-mer

About 20 species are currently exploited in the region, primarily for export to Asia. Recent annual production from Pacific Island countries is about 1 500 tonnes (dried, equivalent to 15 000 tonnes live weight). Villagers can process beche-de-mer into a non-perishable product that can be stored for extended periods awaiting opportunistic transport to markets. The term "pulse fishing" is often used to describe the fishery – long cycles in which a period of intense exploitation is followed by a sharp fall in the abundance of the resource with associated difficulty in maintaining commercial exploitation and then a dormant period in which the resource is able to recover. Information on beche-de-mer fishing in Papua New Guinea is given in Box 2.

***Holothuria atra*, a common species of beche-de-mer**



BOX 2

Beche-de-mer fishing in Papua New Guinea

Papua New Guinea is now the third largest producer worldwide of beche-de-mer, supplying around 10 percent of the global market. Beche-de-mer is not a common "traditional" food in Papua New Guinea, hence almost all of it is exported. They are mainly harvested by hand by free divers, or with spears and lead "bombs" in deeper water. Night fishing with torches and underwater breathing devices are used now despite their prohibition.

Management of the fishery in Papua New Guinea was recognized as necessary because catches have declined since the fishery's inception in the nineteenth century. The government gazetted the *National Beche-de-mer Management Plan* in 2001, which aims to maximize the long-term economic benefits from the fishery, while ensuring resource and environmental sustainability. Factors that contribute to management problems include the remoteness of fishers and the limited human and financial resources of provincial fishery offices. Moreover, export volumes continue to rise as fishers are collecting large quantities of low-value species.

Source: Kinch *et al.*, 2008.

Aquarium fish and invertebrates

Aquarium fish collectors target a large number of species, with the major families being butterflyfish (Chaetodontidae), damselfish (Pomacentridae), surgeonfish

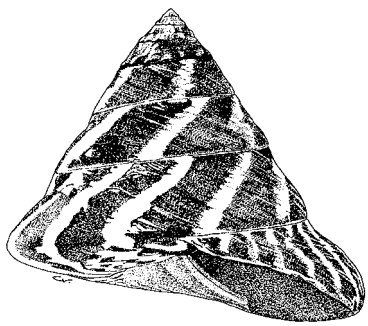
(Acanthuridae) and angelfish (Pomacanthidae). Most aquarium species have the characteristics of relatively small size, bright coloration and good survival in captivity. Many operations also harvest and export invertebrates and live rock. An appealing aspect of the fishery is that aquarium fish are rarely taken for food in the Pacific Islands and, therefore, the fishery does not interfere with subsistence fishing activities. According to SPC (2009b), the Pacific Islands region annually exports 1 million ornamental fish and coral pieces and 700 tonnes of live rock, worth US$59 million. Collection operations have been established in most Pacific Island countries in the last 40 years (Table 6). ADB (2009) shows that aquarium products are one of the major fishery export items in several countries: the Cook Islands, Fiji, Kiribati, the Marshall Islands, Palau, the Solomon Islands, Tonga and Vanuatu.

TABLE 6
Aquarium fish export companies and household participation in Pacific Island countries, 2008

Country	No. of companies	Estimated no. of households involved
Cook Islands	1	10
Federated States of Micronesia	1	20
Fiji	5	600
Kiribati	12	100
Marshall Islands	5	50
Palau	1	30
Papua New Guinea	1	50
Solomon Islands	2	250
Tonga	3	100
Vanuatu	3	100

Source: Kinch and Tietlebaum, 2009.

Trochus niloticus

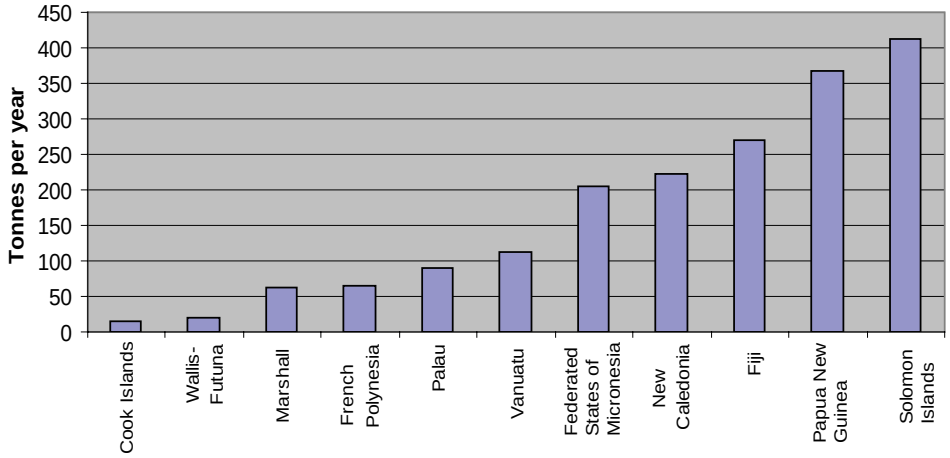


Trochus

Trochus niloticus is commercially one of the most important shellfish in the Pacific Islands. Although the natural range of trochus is limited to the western part of the region, this gastropod has been transplanted to almost all Pacific Island countries. It is valued for the inner nacreous layer of the shell, which, along with that of the pearl oysters and some other shells, is used for the manufacture of "mother-of-pearl" buttons.

The annual harvest of trochus in the Pacific Islands in recent years has been about 2 300 tonnes, with five Pacific Island countries providing most of the harvest (Figure 5). The combined Pacific Islands area is a significant producer of trochus – about 60 percent of the world's trochus

FIGURE 5
Annual harvests of trochus in the Pacific Islands region (tonnes)



Source: Gillett, 2008b.

production. Not a huge amount of trochus is captured in each country but the benefits from these fisheries are substantial. Because little or no equipment is used in the collection of trochus and because the shells may be stored for long periods prior to shipment to market, the trochus fishery is one of the few commercial fisheries feasible for remote communities. In several Pacific Island countries, trochus provides an important source of cash income at the village level, especially since the demise of the copra industry.

Live reef food fish

The live reef food fish fisheries typically harvest certain groups of fish in the tropical Indo-Pacific region and ship them by air or sea to Chinese communities in east Asia. Sadovy *et al.* (2003) indicate that in the main destination markets, the bulk of the trade consists of the groupers (Serranidae). Also taken are snappers (Lutjanidae), wrasses (Labridae), small numbers of emperors (Lethrinidae), sweetlips (Haemulidae), seabream (Sparidae) and members of a few other families. A variety of techniques and gears are used to catch live reef food fish. The major exporter in the region is Papua New Guinea, with sporadic fishing operations in Palau, the Solomon Islands, Fiji and Kiribati. Box 3 gives the main fishing methods used in Papua New Guinea.

It is difficult to determine the quantities of live reef food fish harvested and exported from the Pacific Islands region. Gillett (2008b) estimated 1 500 tonnes, based on the region having 5 percent of the Asia-Pacific trade of 30 000 tonnes cited in Sadovy *et al.* (2003). Although there is considerable interest in several countries to develop this lucrative fishery, there have been numerous problems in the past with the use of cyanide and the unsustainable targeting of fish spawning aggregations.

BOX 3

Live reef food fishing in Papua New Guinea

Two fishing methods are used legally to catch live reef food fish in Papua New Guinea: hand lines and traps. With the use of traps, the choice of bait and fishing time depends on the species targeted. The traps are mainly of rectangular or arrowhead design with a frame of steel or mangrove, covered with chicken wire. The traps are commonly placed by divers using hookah gear.

Although the use of cyanide for fishing is illegal, according to fishers associated with past live reef food fish operations in Papua New Guinea, the chemical is often used. A squirt bottle is used to deliver the cyanide solution as close as possible to the target fish.

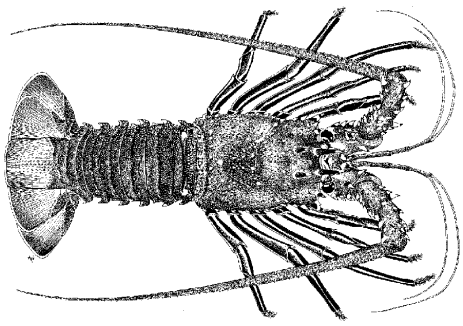
Most operations (legal and illegal) fish from a specially fitted skiff with a seawater compartment that allows free flow of water into the compartment. The captured live fish are held in the compartment for the duration of the fishing operation and travel to a larger carrier vessel where they are kept or further transported to cages anchored off reefs. Fish held on the carrier vessels or in cages need food, which mainly comes from other fishing operations.

Source: SPC, 2001.

Lobsters

The commercial lobster fishery in the region is based on three species of the genus *Panulirus.* The largest fishery occurs in the Torres Strait of Papua New Guinea and targets the ornate spiny lobster (*Panulirus ornatus*). These lobsters annually move off the reefs in the Torres Strait. Some of the migrating lobsters move northeast across the Gulf of Papua, while others move east to deep waters off the northern Great Barrier Reef. In recent years, the catches of this species have ranged from 65 to 115 tonnes (National Fisheries Authority of Papua New Guinea, unpublished data).

Panulirus penicillatus



Smaller lobster fisheries, based mainly on the double-spined lobster (*Panulirus penicillatus*), operate in many Pacific Island countries. The most common fishing method involves walking on reef flats and catching them by hand at night. Spearing is also an important method. Some exports occur but they are rarely sustained. The biological characteristics of this species are such that it is generally unable to support an adequate throughput for an export market (Adams and Dalzell, 1993).

In fact, the history of Pacific Island fisheries is littered with a very large number of failed lobster export operations.

Nearshore pelagics

Trolling for tuna and other large pelagics just outside the reef is practiced in most Pacific Island countries. Table 3 above shows that about 5 percent of the coastal catch in the region consists of tunas and mackerels. Alternatively, Gillett (2005b) estimated that about 19 000 tonnes of tuna are caught annually in the region by "very small-scale tuna fishing" operations. Papua New Guinea, Kiribati and Fiji are likely to have the largest production from coastal trolling. The use of fish aggregation devices (FADs) increases catches and reduces operating costs.

Sport game fishing

Sport game fishing is a specialized form of small-scale commercial fishing that is growing in importance in the region. Table 7 estimates the number of sport game-fishing vessels in the region. The target species range from large coastal pelagics to bonefish. Sport fishers, especially tourists, spend money on vessel charter, accommodation, provisions and shoreside recreation. Another aspect of this fishing is the international tournaments held annually in most countries of the region.

TABLE 7
Game-fishing charter boats in Pacific Island countries

Country	Game-fishing charter boats: numbers and locations
Cook Islands	9 boats working from Rarotonga and 5 boats working from Aitutaki.
Federated States of Micronesia	Several boats associated with tourist hotels.
Fiji Islands	Several charter boats, some associated with tourist hotels.
Kiribati	Nil at present.
Marshall Islands	About 25 charter boats on Majuro plus 10 boats between Kwajalein and Arno.
Nauru	One private sector charter boat.
Niue	1 charter vessel with another charter vessel to start in late 2003.
Palau	About 7 charter fishing vessels in Koror.
Papua New Guinea	Several charter boats around the country, especially at main centres such as Port Moresby, Lae and Madang.
Samoa	4 charter boats, 2 owned by one company.
Solomon Islands	Several charter boats at Gizo.
Tonga	About 8 charter vessels operating out of Vava'u.
Tuvalu	Nil at present.
Vanuatu	About 9 charter boats: 7 boats at Port Vila and 2 boats at Santo.

Source: Chapman, 2004.

Deep-water bottom fish

The target of deep-water bottom fishing in the Pacific Islands is actually a number of fish species that inhabit reef slopes and shallow seamounts that rise to between 100 and 400 m below the surface. In simple terms, fishing for deep-water bottom fish involves locating a suitable deep slope or shallow seamount, positioning the

vessel over the proper depth and using lines with multiple baited hooks to catch the target fish. Boats used at present in the various Pacific Island countries range from small open skiffs to vessels of 15 m capable of making multiday trips to offshore banks and seamounts. The most active export-oriented deep-water bottom-fish fisheries in the Pacific Islands are presently in Fiji and Tonga. Other countries in the region have considerable potential but do not enjoy the convenient air freight connections to the lucrative markets. Information on the export quantities of deep-water bottom fish from Fiji is elusive. Industry sources suggest that Fiji has exported about 150 tonnes annually in recent years. Tonga's exports are slightly more. In the mid-1990s, the Solomon Islands exported nearly 50 tonnes of deep-water bottom fish annually. Table 8 indicates the most important species of deep-water bottom fish in Fiji. SPC has been involved in the promotion of deep-water bottom-fish fishing for many decades. Its experience in developing, assessing and managing these fisheries is well documented and available on the SPC Web site www.spc.int.

TABLE 8
Important deep-water bottom fish of Fiji

Scientific name	Common name	Export status
Etelis carbunculus	Ehu	Dominant.
Etelis coruscans	Onaga	Dominant.
Etelis radiosus	Smalltooth snapper	Probably included in Ehu exports.
Pristipomoides multidens	Purplecheek opakapaka	This is the most common Fiji species and is well received on the export market.
Pristipomoides flavipinnis	Yellow-finned Opakapaka	An export species used in the whole deep-fried fish market because of its smaller size.
Pristipomoides filamentosis	Opakapaka	The most desirable Pristipomoides species.
Pristipomoides zonatus	Gindai	A specialty Hawaii export species.
Pristipomoides typus	Red-tailed opakapaka	This species is not very common.
Aphareus rutilans	Lehi	Dominant.
Wattsia mossambica	Large-eye bream	Local market.
Paracaesio kusakarii	Bedford	Local market.
Paracaesio stonei	Stone's snapper	Local market.
Lutjanus malabaricus	Rosi ni bogi	Occasional export to Hawaii.
Epinephelus magniscuttis	Hapu	Exported.
Epinephelus miliaris	Hapu	Exported.
Epinephelus morrhua	Hapu	Exported.
Epinephelus septemfasciatus	Hapu	Exported.
Seriola rivoliana	Kahala	Not exported to Hawaii due to Ciguatera.

Source: Stone, 2006.

Penaeid shrimp

Although there is subsistence fishing for marine and freshwater shrimps in most Pacific Island countries, the only shrimp fisheries in the Pacific Islands that produce significant exports are the four trawl fisheries located in Papua New Guinea. Characteristics of the Papua New Guinea fishery are given in Gillett

(2008a). Fishing takes place primarily in the Gulf of Papua, with all vessels being based in Port Moresby and carrying out prolonged voyages (about a month) with on-board processing, freezing and packing of catch. The vessels operating in the Gulf of Papua typically fish close to shore in waters up to depths of about 45 m. The fishery is based on the banana prawn (*Penaeus merguiensis)* and to a lesser extent the giant tiger prawn (*Penaeus monodon).* Production from the Papua New Guinea shrimp trawl industry has been variable over the last two decades. The maximum catch recorded from the fishery was 1 870 tonnes in 1979, but annual production typically varies between 400 and 1 300 tonnes.

EXPORT PRODUCTS FROM COASTAL COMMERCIAL FISHERIES

Much commercial production from coastal areas in the Pacific Islands is exported. In general, the region exports high-value commodities, while importing mainly inexpensive food supplies, such as canned mackerel. Fisheries development efforts in the region have largely been oriented towards export products. With the increased global demand for and subsequent price rise of fishery products, the incentive to export will increase. As this trend continues, there is some cause for concern. Some of the fisheries oriented towards the export of, for example, giant clams have interfered with this traditional source of food and have even been destructive (live fish trade to Asia). In some cases, the benefits of export fisheries accrue to a few individuals, while the adverse side-effects may be experienced by many people (e.g. the export of live coral). Information on the quantity of exported fishery products is often insufficient to gauge the benefits of the fishery or assess the sustainability. Table 9 is an attempt to estimate the volume of exports from Pacific Island coastal fisheries.

STATUS OF COASTAL FISHERY RESOURCES

In general, the coastal fishery resources are heavily fished and often show signs of overexploitation, especially in areas close to population centres and for fishery products in demand by the rapidly growing Asian economies. The coastal fisheries are also negatively affected by habitat degradation, which occurs from destructive fishing practices, urbanization, siltation from mining and logging, and competing uses of the coastal zone.

On a more detailed level, the degree of exploitation of coastal finfish is generally related to the distance to urban markets. The perishable nature of finfish has a limiting effect on fishing pressure in rural areas. By contrast, the products of commercial invertebrate fishing are mostly non-perishable. SPC (2008a) states that most sites surveyed in the Pacific Islands are "seriously depleted of commercial invertebrate resources". Another aspect of the invertebrate fisheries in the region is variability. Dalzell and Schug (2002) state that commercial harvests of invertebrates are characterized by boom and bust cycles, and in some cases the bust part of the cycle has persisted with no indication of recovery.

In early 2009, SPC completed a project that was oriented towards identifying specific indicators that can be used for long-term monitoring of the status of reef

TABLE 9
Exports from Pacific Island coastal fisheries

Commodity	Tonnes per year	Country/territory origin of exports	Source of information
Beche-de-mer	1 500 tonnes (dried, equivalent to 15 000 tonnes live weight).	The major exporters are Papua New Guinea, the Solomon Islands, Fiji and New Caledonia.	SPC data.
Trochus	2 300 tonnes of shell during the last decade.	The major exporters are Papua New Guinea, the Solomon Islands, the Federated States of Micronesia, Fiji and New Caledonia.	Data from Gillett, 2008a.
Deep-water bottom fish	350 tonnes in recent years.	The major exporters are Fiji and Tonga.	G. Southwick, D. Lucas and B. Holden (pers. comm.); Wilson, 2007.
Giant clam	20 tonnes of adductor muscle, plus shells. Quantities are declining due to resource exhaustion and export controls.	Some exports from most Pacific Island countries in the past. Now many countries have export bans on meat. The Solomon Islands is the major shell exporter.	SPC data; CITES data also available.
Live reef food fish	1 500 tonnes.	The major exporter is Papua New Guinea, with sporadic operations in Palau, the Solomon Islands, Fiji and Kiribati.	Estimate based on 5 percent of the Asia-Pacific trade of 30 000 tonnes cited in Sadovy *et al.*, 2003.
Aquarium fish and invertebrates	The region annually exports a million ornamental fish and coral pieces and 700 tonnes of live rock.	Harvesting operations in most Pacific Island countries.	SPC, 2009b.
Lobster	From 80 to 100 tonnes.	Mainly from the Torres Strait between Papua New Guinea and Australia.	National Fisheries Authority of Papua New Guinea (unpublished data) and K. Friedman (pers. comm.).
Prawns	600 tonnes.	All from Papua New Guinea.	Gillett, 2008a, using various primary sources.
Other	Considerably less quantities than the quantities of the abovementioned commodities.	Minor exports from several countries: crabs, green snail, oysters, specimen shells, shells in handicrafts, barramundi and shallow-water reef fish.	

fisheries. A huge amount of data was collected over six years in field surveys in 17 island groups of the region. In some respects, the status of that work is indicative of the general state of the monitoring of coastal fishery resources in the region. SPC (2008c) comments: "We are still a long way from being able to estimate fishing mortality in reef fisheries as we do in tuna fisheries, and because most governments and fishing communities do not collect information from fishers, we're even a long way from being able to estimate fishing effort. However, by using various survey samples, particularly household consumption and fishing effort surveys, it is possible to develop a rough indicator of fishing pressure at different sites and islands, in terms of number of active fishers per unit reef area".

MANAGEMENT OF COASTAL FISHERY RESOURCES

Historical background

In former times, most coastal communities in the Pacific Islands had some type of management of adjacent marine resources. Management was often in the form of

community leaders restricting access by outsiders and imposing various kinds of harvest bans for residents. The current thinking is that those mechanisms worked reasonably well in the context in which they were used but it should be noted there have been a multitude of changes in management conditions, including:

- The populations of the various island groups were considerably smaller than the populations of today.
- Markets for coastal resources have developed and commercialization is now a major factor influencing fishing effort.
- The authority of community leaders, a basic element in local coastal resource management, has eroded through both changes in society and alteration to legal and regulatory regimes.
- External threats over which the community has little control (e.g. logging, pollution) are greater now than in the past.

The net result of these changes has been a marked decrease in effectiveness of the former systems of coastal resource management, especially near urban areas.

Although there is considerable variation among Pacific Island countries, the general pattern is that, during the colonial period, centralized forms of resource management were introduced to most Pacific Island countries by the mainly expatriate fishery administrators. The first 50 years of the twentieth century were characterized by government indifference to marine issues (Adams, 1997). In the mid-1950s, most Pacific Island governments starting using various forms of fishery management measures, most typically through restrictions (gears, seasons, quotas, areas) stipulated as regulations under national fisheries laws. Although the new central regimes were often supported by legal systems, there was little technical backup or enforcement activity, especially in the areas away from urban centres.

Centralized management was also characterized by the fairly optimistic assumption that, through biological and economic studies of coastal resources, it would be possible to optimize the benefits from a fishery. In general, the studies were sophisticated but the government capability or desire to implement management was low.

Starting in the early 1970s, both fisheries managers and the environmental community began using marine protected areas (MPAs) as management tools. A decade later, the concept of community-based MPAs gained momentum. Research by R. Johannes led to the book *Words of the Lagoon* (Johannes, 1981) and a much greater appreciation of the value of using indigenous knowledge in resource management.

Recognizing the difficulties associated with restriction-oriented coastal management, there have been many decades of efforts to encourage inshore fishers to diversify into deep-slope or offshore fisheries (bottom fish/tuna). There is a long history of aquaculture promotion in the region and one rationale for this is that the culture of marine organisms could lead to reduced pressure on coastal resources.

The current situation in the Pacific Islands area

The management of coastal fishery resources in many Pacific Island countries is a mixture of several systems:

- Traditional management. This is most prevalent in rural areas and characteristically involves village leaders restricting the fishing by those outside the community and by various controls on fishing by community members.
- Central government management. All Pacific Island countries have a fisheries law giving wide powers to the government fisheries agency in controlling fishing activity. For various reasons, the system is mostly ineffective, with the situation in Tonga (Box 4) serving as an example. There is some degree of success, however, in the application by central governments of point-of-export restrictions on the coastal resources that are exported.
- The use of MPAs and similar arrangements. Communities, with varying degrees of outside assistance, establish an area that is closed to fishing or is subjected to reduced fishing pressure.

BOX 4

Difficulties with coastal fisheries management in Tonga

Coastal fisheries management in Tonga is attempted on a centralized basis. Fisheries legislation is enacted in the capital. Similarly, the management section in the Ministry of Fisheries and all of the section's staff is located in the capital. For budgetary and other reasons, the staff members are rarely able to travel to other island groups in Tonga. In reality, fisheries laws made in the capital have little effect on the situation in the outer islands and remote villages where there is frequently no authorized enforcement officer or even knowledge of the fisheries laws. In urban areas, there are also problems with the nature of fisheries laws. Although the legislation is reasonably comprehensive, enforcement and prosecution can be impractical in the context of Tongan society wherein lack of social friction is important. For example, in the past three years, despite no shortage of illegal activity, there has been only one successful prosecution for a fisheries offense and that involved two non-Tongans.

Source: Petelo, Matoto and Gillett, 1995.

It is ironic that although the fisheries that produce export products should be relatively easy to manage, this is not often the case. The SPC sees an opportunity to improve the situation (Box 5).

Current coastal fishery management measures (both centrally-administered and community-driven) tend to be non-quantitative and are intended to protect stocks in a generalized way (Preston, 2008). The measures include MPAs, size limits (both minimum and maximum), gear restrictions (minimum mesh sizes for

BOX 5

The approach of the SPC to improving invertebrate export fisheries

Beche-de-mer and mother-of-pearl have been commercially exported from the Pacific Islands for over a century. They are simple to process, non-perishable and the trade in these products pumps significant amounts of cash directly into rural coastal communities, which have few alternative sources of income.

Pacific Island countries and territories are significant market suppliers of these high-value products, e.g. Papua New Guinea alone supplies 10 percent of the world's bêche-de-mer market (annual value US$11.5 million), and Fiji, the Solomon Islands and Papua New Guinea together have produced more than 50 000 tonnes of trochus shell since World War II (total value over US$200 million).

However, these resources are chronically overfished and would yield much greater income if they were more actively managed. The costs of conventional management (such as management applied to tuna fisheries) would be unrealistic but these fisheries have unique aspects that a more regional approach can take advantage of. One favourable factor is that they are not food security fisheries and thus harvesting can occur in "pulses" that can take advantage of optimum markets. In addition, the harvesting side is amenable to community rights-based management. With a little cooperation and active attention, it should be possible to, relatively quickly, turn around the least productive fisheries in the region into models of sustainability.

Source: SPC, 2008a.

nets, bans on torch fishing at night), prohibitions on the use of destructive fishing methods (blast fishing, poisons) and on the taking of berried females, and seasonal or area closures.

Some management measures are ongoing, such as a minimum size for trochus or beche-de-mer, while other measures require a "trigger", e.g. total catches of beche-de-mer fall to a low level, initiating a complete ban on beche-de-mer fishing. Other triggers for management action include low abundance of the target species as noted by a fishery independent field survey (giant clams in several countries), the discovery of illegal activity (the use of cyanide by live fish operations), complaints by villagers (scuba spearfishing at night) and falling catch per unit effort (Tonga deep-water bottom fishery).

Many current management measures are in support of biological objectives. The biological objective is most often stock sustainability, i.e. prevention of resource collapses (rather than catch optimization). There are also management measures for purely economic objectives, such as encouraging in-country trochus processing. Cultural objectives, such as the closure of a reef to fishing after the death of a traditional leader to show respect, are also common.

Recent developments

MPAs

The Pacific Islands have experienced a remarkable proliferation of MPAs and similar community management arrangements. Older models of larger, centrally planned reserves have failed in almost all cases. A newer approach, built on existing community strengths in traditional knowledge and governance, and using local awareness of the need for action, has been quite successful. In fact, a survey of 15 independent countries and territories in the south of the Pacific Islands region showed that over 500 communities have established these protected areas, which cover over 12 000 km^2 (Govan, 2009).

The Pacific Islands Forum is a meeting of the heads of state and government of the Pacific Island countries plus Australia and New Zealand. The 37th Pacific Islands Forum meeting took place in Tonga in mid-October 2007. The meeting gave special and unprecedented prominence to fisheries and adopted the Vava'u Declaration on Pacific Fisheries Resources. The Declaration asserts the importance of fisheries to the economies of Pacific Island countries and calls for *inter alia* additional attention to be focused on the management of coastal/inshore fisheries to support food security, sustainable livelihoods and economic growth for current and future generations of Pacific people.

To meet the expectation of Pacific Islands leaders under the Vava'u Declaration, the Pacific Islands Regional Coastal Fisheries Management Policy, known as the Apia Policy, was developed by 18 Pacific Island countries and territories during the special session of the SPC Heads of Fisheries meeting held in Apia in February 2008. The implementation of the strategic actions under the regional policy is guided by six principles, considered to be essential for the successful management of coastal fisheries and its environment. These principles are:

1. Improving our understanding of important fisheries species and of the ecosystems on which they depend;
2. Sustainably managing coastal fisheries, reducing their adverse impacts on coastal ecosystems and optimizing production to meet local nutritional needs and contribute to economic development;
3. Creating community partnerships to support the customary and traditional management of nearby ecosystems and fish stocks;
4. Creating stakeholder collaborations to manage ecosystems and reduce the negative environmental impacts of non-fisheries activities, including those causing high loads of silt and nutrients in coastal waters;
5. Promoting the participation of women and youth in all fisheries-related activities; and
6. Enhancing the regional exchange and sharing of information regarding common interests relating to the management of ecosystems and fisheries.

Ecosystem approach to fisheries management (EAFM)

There has been a considerable amount of recent activity associated with applying the EAFM to coastal fisheries in the region:

- The Vava'u Declaration commits leaders to "*the development and management of coastal/inshore fisheries and aquaculture to support food security, sustainable livelihoods and economic growth…*" and "*to maximise sustainable returns from fisheries by developing an ecosystem based fisheries management planning framework…*".
- The goal of the SPC's Coastal Fisheries Programme, as stated in its Strategic Plan 2007–2009, is "*to assist SPC members in their commitment to implement the Ecosystem Approach to Coastal Fisheries and Aquaculture by 2010*".

Preston (2008) reviews the current EAFM situation in the region. Essentially the ecosystem approach requires taking into consideration the effects of human actions on every element of an ecosystem, based on the recognition that the effects are all linked. Preston states that few, if any, Pacific Island countries have enacted legislation or declared policies that commit them to the implementation of the EAFM. Despite this, however, many countries have implemented fisheries management measures that are compliant with the EAFM and that are assisting in the implementation of EAFM in a de facto manner. Such measures include the promotion of community-based management or co-management arrangements, establishment of MPAs and marine managed areas, addressing specific non-fishery issues (such as waste disposal) that affect marine resources, and a range of technical measures intended to protect and conserve fish stocks. All the major regional organizations involved in fisheries, as well as several international agencies and a number of non-governmental organizations (NGOs) are already encouraging adoption of the EAFM and are able to provide support and assistance in its implementation.

Livelihood diversification

Livelihood diversification has been promoted as a tool for marine resource management in the Pacific Islands for at least 30 years. The concept is that alternative or supplementary sources of income or food to that obtained from inshore fishing could be used to relieve fishing pressure on inshore marine resources. Because of the widespread past and present use of the technique as a fishery management tool in the region, the WorldFish Center and SPC undertook a study in 2007 of the effectiveness of this tool. Box 6 summarizes the study results.

SOME IMPORTANT ISSUES RELATING TO COASTAL FISHERY RESOURCES AND THEIR MANAGEMENT

It could be argued that the major issue of concern with respect to coastal fishery resources in the Pacific Islands region is a rapidly expanding population coupled with a coastal fisheries production that is not increasing. Table 10 lists historical estimates of coastal fisheries production and population for the independent

BOX 6

Livelihood diversification as a marine resource management tool

Four main types of activities have been promoted in the region as alternatives to inshore fishing with the aim of reducing fishing pressure: aquaculture, fishing with fish aggregation devices (FADs), deep-slope fishing and alternative activities outside the fisheries sector (e.g. ecotourism, livestock raising, surfing, handicrafts).

The results of the WorldFish Center and SPC study show that, in reviewing marine resource management in the Pacific Islands over the last three decades, it is difficult to identify cases where the use of livelihood diversification as an inshore management tool could be considered clearly successful. The most important result of the study is that the performance of livelihood diversification in the Pacific Islands has not been to the level at which it can be considered an effective resource management tool.

In many cases, livelihood diversification could even be a distraction that deters communities from gaining an awareness of the need for, and benefits of, more effective forms of marine resource management. Often the assumption is that extra cash or food will remove fishing pressure but the actual situation of what motivates and discourages individuals and communities from fishing is far more complex.

Source: Gillett *et al.*, 2008.

TABLE 10

Annual production of coastal fisheries from 1960 to 2007

Source	Period	Coastal fisheries production (tonnes)	Population of the region	Per capita fish supply from coastal fisheries (kg)
Van Pel, 1961	1960	31 420	3 150 000	10.0
Crossland and Grandperrin, 1979	Late 1970s	55 130	4 410 000	12.5
Adams and Dalzell, 1994	Early 1990s	108 242	6 068 000	17.8
ADB, 2009	2007	154 722	9 315 395	16.6

countries and the territories combined. The data for the various periods is not strictly comparable (i.e. different methodologies and rigor associated with the estimates) and there are complicating factors (large inland population in Papua New Guinea, freshwater fisheries production), but the basic concept is valid: a stagnant or decreasing amount of food and employment from coastal fishing is being spread among a growing number of people. Because the Pacific Islands region is so highly dependent on coastal fisheries for food and employment, this is a major concern.

Another major issue of concern involves fisheries governance. Although the capability of government fisheries agencies is critically important in assuring sustainability of coastal resources, many of these agencies are deficient in

various areas. They lack technical capability, productivity incentives, structure and responsiveness. In addition, their attention is being increasingly consumed by matters relating to the management of the region's tuna resources, with less attention to coastal resources. Furthermore, there are problems with the priorities of many government fisheries agencies; in several countries the fishery policies, fisheries department activities and staff experience appear to be "stuck in the 1960s". There needs to be a transition from government-led development of what are often non-existent opportunities in coastal fisheries to the concept that fisheries departments, their officers and communities are guardians of marine resources.

Another important issue in the management of coastal fishery resources is pointed out by Birkeland (1997). The rapid economic growth of Asian nations, especially mainland China, is putting a new type of pressure on marine resources. In normal circumstances, economics compel fishers to switch gear or locations before the resource population nears local extinction. However, the high dollar value placed on many coral reef resources by Asian economies can encourage effort even after the targeted species is too rare to sustain a viable reproductive population. The rapid increase in the dollar value of reef resources overrides management policies, traditional practice and law.

BOX 7

What is coral bleaching?

Coral bleaching is a descriptive term applied to the influence of higher sea temperatures on a variety of coral reef organisms, which include sea anemones and giant clams as well as corals. What they all have in common is the internal presence of symbiotic algae, the zooxanthellae. Prolonged, unusually high sea temperatures, cause physiological problems and the algae are expelled from the host organisms. The resulting appearance of coral or other organisms is a lightening or whiteness, though the inherent coloration of the animal host may dominate, commonly as purple, blue or yellow.

During late February to early March 2000, mass bleaching occurred in Fiji after a prolonged period of temperatures in excess of 30 °C. This coincided with similar coral bleaching being reported across the South Pacific from Papua New Guinea to Easter Island. Other Pacific Island countries such as Kiribati, Tuvalu and Samoa experienced no coral bleaching during that year. A major bleaching occurred subsequently in Fiji in 2002 and mainly affected the coral in the waters off the north shores of the two main islands, which had escaped the 2000 bleaching. During the period 2003–2005, the incidence of bleaching was low in Fiji. Kiribati suffered severe bleaching in 2003 in the Phoenix Islands and in 2005 in the Gilbert Group. Limited bleaching occurred in Fiji in 2006 and in 2009.

Source: Lovell, 2009

Climate change will cause rising sea-surface temperatures and more acidic oceans. These changes are projected to have increasingly severe impacts on the growth of hard corals, including mass "coral bleaching" (Box 7). Significant changes can be expected in the availability and relative abundance of the fish and invertebrates that currently support coastal fisheries in the Pacific (Bell, 2009).

The number of NGOs involved in aspects of managing coastal marine resources in the region has grown substantially in recent years. In addition to local organizations, a number of international NGOs have commenced programmes that involve coastal marine resources. These organizations include the Worldwide Fund for Nature, Greenpeace, the Nature Conservancy, the Wildlife Conservation Society, Conservation International, Foundation of the Peoples of the South Pacific and several smaller groups. The increased attention, awareness and educational activities that these organizations bring are certainly positive. In some situations, there is, however, an issue over how the roles of these NGOs relate to the functions of the government fisheries agencies (i.e. displacing of functions). One view is that an important niche for NGO involvement in fisheries in the Pacific is to alert national governments to developments that represent new or growing threats to coastal resources and to take some initial action that may catalyse more comprehensive action on the part of government fisheries agencies. In any case, there is a real need for coordinating the activities of NGOs and government fisheries agencies.

SPC (2008c) points out an issue that is growing in importance in many Pacific Island countries: "Coastal fisheries are 'mature' in fishery development terms and the main focus with reef fisheries is on consolidation and protection of current benefit. If anything, the main prospects for economic and livelihood development from reef resources, over and above maintaining current levels of production, lie not in fisheries but in tourism and other non-extractive uses".

5. Offshore fishery resources

Offshore resources, one of the two main categories of the region's marine fishery resources, will be discussed in this chapter. Offshore include tunas, billfish and allied species. These resources are characterized by an open-water pelagic habitat, potentially extensive individual movements and wide larval dispersal. They form the basis of the region's industrial fisheries. Although oceanic in habit, some of the important species in this category are also found and harvested in coastal waters, where in some cases they are thought to form essentially resident populations.

SOURCES OF INFORMATION ON OFFSHORE FISHERY RESOURCES

A substantial amount of information is readily available on the offshore fishery resources of the Pacific Islands, on both regional and national levels. The most important source is, without doubt, the OFP of the SPC. A knowledge of the role of OFP is essential for understanding the offshore resources of the region and the associated research (Box 8).

The main documents of the OFP that have proven especially useful for understanding the offshore resources are:

- An SPC policy brief titled *Tuna Fisheries and Their Impacts in the Western and Central Pacific Ocean.* This short document gives a good overview of tuna resources in the region and their management.
- *Western and Central Pacific Tuna Bulletin*. The bulletin presents tables of monthly catch rates for selected longline, pole-and-line and purse-seine fleets operating in the Western and Central Pacific Fisheries Commission (WCPFC) statistical area. Maps of catches, plots of catch rates and histograms of annual catches are also presented. The tuna bulletin is prepared by the OFP under contract to the WCPFC.
- *WCPFC Tuna Fishery Yearbook*. The yearbook presents annual catch estimates in the WCPFC statistical area from 1950 onwards. The tables of catch statistics cover the four main commercial species caught in the region. The yearbook is prepared by the OFP under contract to the WCPFC.
- A series of OFP research publications. These publications cover a wide variety of topics related to the tuna resources of the region, including impacts of tuna fishing, predictions on tuna distribution, effects of the environment on tuna distribution, impacts of El Niño, tuna mortality, population modeling, exploitation and movement of tuna and the pelagic ecosystem in the region.
- Papers prepared by OFP for the WCPFC Scientific Committee. Examples from the 2008 meeting are *Stock Assessment of Bigeye Tuna in the Western*

BOX 8

The Oceanic Fisheries Programme (OFP)

SPC's OFP, formerly known as the Tuna and Billfish Assessment Programme, was established in 1980 by SPC's governing body, the South Pacific Conference, to continue the work initiated by its predecessor project, the Skipjack Survey and Assessment Programme. The ongoing expenses of the programme are currently funded by extrabudgetary contributions from Australia, France and New Zealand, and a contribution from the SPC core budget. Specific projects during the last five years have been funded by numerous donors.

The OFP mission is "*to provide member countries with the scientific information and advice necessary to rationally manage fisheries exploiting the region's resources of tuna, billfish and related species*".

The OFP has three sections, each headed by a principal-level officer: Statistics and Monitoring, Tuna Ecology and Biology, and Stock Assessment and Modelling, with common functions (reporting and liaison, information technology and computer support) supported by a small administrative section.

Source: SPC Web Site (www.spc.int)

and Central Pacific Ocean (Langley *et al.*, 2008) and *Overview of Tuna Fisheries in the Western and Central Pacific Ocean* (Williams and Terawasi, 2008).

A very large amount of documentation on the tuna resources of the region is presented by various agencies to meetings of the WCPFC, especially the Scientific Committee. At the August 2008 meeting, over 100 technical documents on national and regional aspects of tuna resources and their management were presented.

Other agencies that have provided a substantial amount of useful information on offshore resources of the region are the Pelagic Fisheries Research Program of the University of Hawaii, the Pacific Islands Regional Office of the National Marine Fisheries Service, FAO, ADB and Japan's National Research Institute of Far Seas Fisheries.

IMPORTANT OFFSHORE FISHERY RESOURCES

Although several species of scombrids are found in the Pacific Islands area, four species of tuna are of major commercial importance: skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*T. obesus*) and albacore tuna (*T. alalunga*). Table 11 gives information on these fish in the western and central Pacific Ocean (WCPO).

Another important target of offshore fishing is swordfish (*Xiphias gladius*). Swordfish are caught by relatively shallow longline gear mainly in the subtropical parts of the WCPO.

A few billfish species and some sharks are targeted by specific fisheries, but more usually they are bycatch in tuna longlining and, to a lesser extent, tuna purse seining. The common billfish are: black marlin (*Makaira indica*), blue marlin (*M. mazara*), sailfish (*Istiophorus platypterus*), shortbill spearfish (*Tetrapturus angustirostris*) and striped marlin (*T. audax*). The most common shark caught is the blue shark (*Prionace glauca*) but the sharks that are occasionally subjected to targeting (or are valuable enough to retain) are the oceanic white tip (*Carcharhinus longimanus*), the silky shark (*C. falciformis*), the short-fin Mako shark (*Isurus oxyrinchus*) and three species of the thresher shark (*Alopias* spp.).

IMPORTANT TYPES OF OFFSHORE FISHING

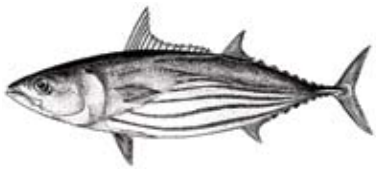
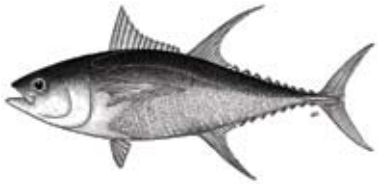
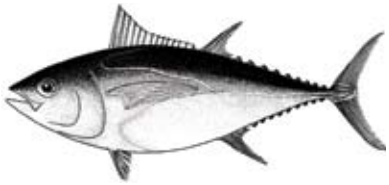
Historical background

Fishing for tuna has been important in Pacific Island countries for centuries. Tuna fishing lore forms a significant part of the cultural heritage of the region. The classic *Notes on the Offshore Fishing of the Society Islands* (Nordoff, 1930) describes several of the traditional tuna fishing techniques and states: "an accomplished fly-fisherman in Europe or America does not carry in his head one-half the store of practical knowledge a traditional skipjack fisherman uses every day". Today most tuna caught by small-scale fishers in the region is taken by trolling from small outboard-powered craft.

The history of industrial tuna fishing in the region is closely related to Japan's economic development activities in the area. After World War I, Japan was awarded control of much of Micronesia by a League of Nations mandate. Japan subsequently directed substantial effort to developing the fishing industry of its newly acquired territories. Three commercial tuna pole-and-line fishing operations were established in Palau in the late 1920s. By the mid-1930s, Japanese tuna fishing was well developed in the area, with 45 pole-and-line vessels based in Palau, 52 vessels in the Federated States of Micronesia and 19 vessels in the Northern Mariana Islands. Tuna catches in Micronesia reached their highest level of 33 000 tonnes in 1937. Table 11 shows the tuna species of major commercial importance in the region. All commercial tuna fishing in the area came to a halt during World War II.

Tuna fishing activity in post World War II Micronesia was remarkably different. Much of the fishery infrastructure and tuna vessels were destroyed by war activity. As part of the terms of war surrender, geographic restrictions known as MacArthur Lines, were placed on the movements of Japanese vessels, which effectively prevented their tuna fishing in Micronesia. These lines were relaxed four times and finally the last line was lifted in April 1952. The Japanese then became active in establishing tuna facilities in the Pacific Islands area. Between the early 1950s and the early 1960s, bases for tuna longline vessels were established in Pago Pago (American Samoa), Santo Island (Vanuatu), Noumea (New Caledonia), Papeete (French Polynesia) and Levuka (Fiji). At the same time, the Japan-based pole-and-line vessels continued to expand their range and fishing operations,

TABLE 11
The tuna species of major commercial importance in the region

Tuna species		Typical size captured	Important aspects
Skipjack		40 to 70 cm	Skipjack are caught mainly on the surface by purse-seine and pole-and-line gear and used for producing canned tuna. Most fish caught are from one to three years old. In the WCPO, the skipjack biomass is greater than that of the other three main tuna species combined.
Yellowfin		40 to 70 cm and 90 to 160 cm	Small yellowfin are caught on the surface by purse-seine and pole-and-line gear, while larger/older fish are caught in deeper water using longline gear. Small fish are used mainly for canning, while high quality larger fish are often shipped fresh to overseas markets. Most fish caught are from one to six years old.
Bigeye		40 to 70 cm and 90 to 160 cm	Small bigeye are caught on the surface by purse-seine and pole-and-line gear, while larger/older fish are caught in deeper water using longline gear. Small fish are used mainly for canning, while high quality larger fish are especially valuable as fresh fish in the Japanese market. Most fish caught are from one to ten years old. Bigeye tuna account for a relatively small proportion of the total tuna catch in the region, but these tuna are extremely valuable.
Albacore		60 to 110 cm	Small albacore are caught by trolling at the surface in cool water outside the tropics, while larger fish are caught in deeper water and mainly at lower latitudes using longline gear. Most of the catch is used for producing "white meat" canned tuna. Fish caught are typically from one and a half to ten years old.

Source: Drawings are courtesy of SPC.

eventually reaching even the southern parts of the Pacific Islands area, with 300 pole-and-line vessels participating seasonally in the fishery.

A remarkable change occurred when purse-seine tuna gear was adapted for use in the region. Box 9 gives an account of that process.

The current situation in the Pacific Islands area

In 2007, about 1 080 000 tonnes of tuna were caught in the EEZs of Pacific Island countries. Figure 6 gives the breakdown by species and Figure 7 gives the breakdown by capture method. Table 12 gives the main types of industrial tuna fishing currently used in the region.

BOX 9

The development of tuna purse seining in the Pacific Islands

Primarily due to expanding Japanese tuna catches in the 1950s, the California-based pole-and-line fishery (almost 300 vessels) experienced severe financial difficulties. The fleet survived largely through technical innovations that led to the feasibility of using purse-seine gear for capturing tuna in relatively cool water. In subsequent years, nearly 100 California bait boats were converted to purse-seine vessels and new tuna purse-seine vessels were constructed. The technique later was taken up by Japanese tuna fishers for use in temperate waters off Japan. By the late 1960s, between 60 and 70 small Japanese tuna purse-seine vessels were fishing seasonally.

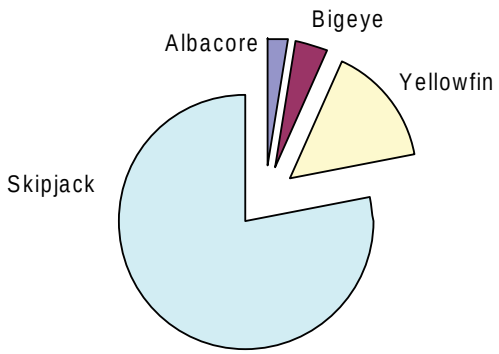
Tuna purse seining in tropical waters was another matter. The characteristically clear water and deep thermocline in the equatorial Pacific create conditions unfavourable for purse seining – the tuna schools tended to be smaller, faster-moving and dive deeper than in the eastern Pacific or in the waters off Japan. The governments of Japan and subsequently of the United States sponsored many experimental purse-seining expeditions to the equatorial Pacific area. The Japanese persisted and were the first to have success.

The main innovation was the pre-dawn setting of deep nets around logs in the area between Micronesia and Papua New Guinea. By the late 1970s, there were several fully commercial Japanese and American purse-seine operations in the western equatorial area of the Pacific Islands. The number of purse-seine vessels operating in the Pacific Islands increased rapidly during the early 1980s. The American purse-seine fleet moved in quickly from the eastern Pacific due to the very strong El Niño event of 1982–1983 and pressure to reduce dolphin mortality in its traditional fishing grounds. In the mid-2000s, nearly 200 tuna purse seine-vessels from 18 countries operated in the Pacific Islands region.

Source: Gillett, 2007.

FIGURE 6

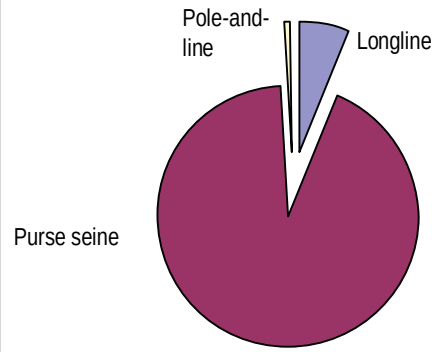
Composition of the tuna catch in the EEZs of Pacific Island countries, 2007



Source: FFA/SPC unpublished data.

FIGURE 7

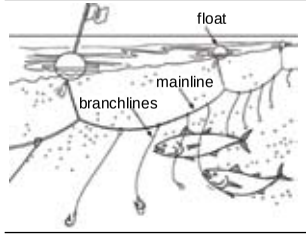
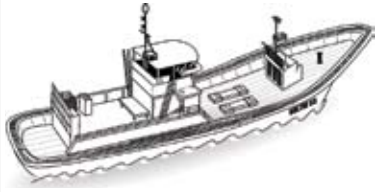
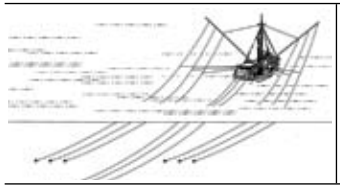
Capture method of the tuna catch in the EEZs of Pacific Island countries, 2007



Source: FFA/SPC unpublished data.

TABLE 12

Main types of industrial tuna fishing in the region

Gear type	Catch	Typical vessel	Notes
Purse seine			
	Mainly skipjack and small yellowfin are caught by purse-seine gear. Most catch is for canning.		About 72 percent of the tuna catch in the WCPO region is by purse-seine gear. Most of the purse-seine catch is taken within 5 degrees of the equator.
Longline			
	Most tuna caught are large-size yellowfin, bigeye and albacore. The prime yellowfin and bigeye often are exported fresh to overseas markets. Most of the albacore is for canning.		About 10 percent of the tuna catch in the WCPO region is by longline gear. There are two major types of longliners: (1) relatively large vessels with mechanical freezing equipment (often based outside the Pacific Islands), and (2) smaller vessels that mostly use ice to preserve fish and are typically based at a port in the Pacific Islands.
Pole-and-line			
	Mainly skipjack and small yellowfin are caught by pole-and-line gear. Most catch is for canning or producing a dried product.		About 10 percent of the tuna catch in the WCPO region is by pole-and-line gear. In the 1980s, several Pacific Island countries had fleets of these vessels but most of them no longer operate because of competition from the more productive purse-seining operations. Most of the catch by this gear is made in Asian waters.
Trolling			
	Large-scale trolling targets albacore for canning.		Gear types other than the three types listed above are responsible for almost 10 percent of the tuna catch in the WCPO. Large-scale trolling is an important part of this activity. It is carried out in the cool water to the south and north of the Pacific Islands region.

Source: Gillett and Bromhead, 2008.

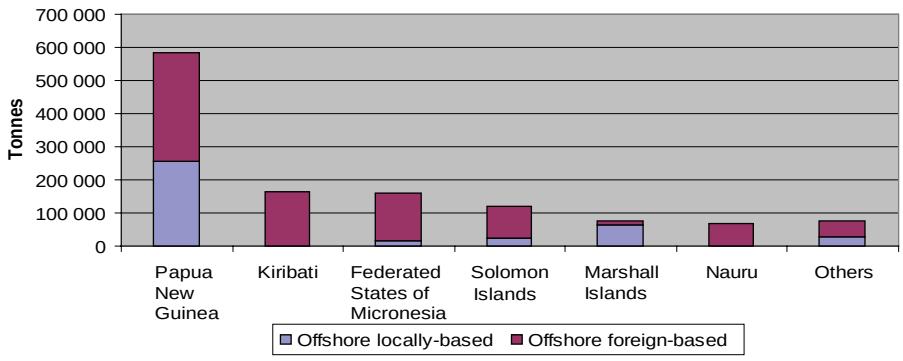
The abovementioned catches are made by both tuna vessels based in Pacific Island countries and tuna vessels based outside the region. Table 13 partitions the offshore catch by country and by type of base. This is shown graphically in Figure 8. It can be seen that almost 70 percent of the offshore catch in the EEZs of Pacific Island countries is made by vessels based outside the region. Vessels in Papua New Guinea are responsible for about two-thirds of the catch made by locally-based vessels.

TABLE 13
Volume of fisheries production by country and base location of vessels, 2007 (tonnes)

Country	Offshore locally-based vessels	Offshore foreign-based vessels	Total (tonnes)
Papua New Guinea	256 397	327 471	583 868
Kiribati	0	163 215	163 215
Federated States of Micronesia	16 222	143 315	159 537
Solomon Islands	23 619	98 023	121 642
Marshall Islands	63 569	12 727	76 296
Nauru	0	69 236	69 236
Tuvalu	0	35 541	35 541
Fiji	13 744	492	14 236
Vanuatu	0	12 858	12 858
Palau	3 030	1 464	4 494
Cook Islands	3 939	0	3 939
Samoa	3 755	25	3 780
Tonga	1 119	0	1 119
Niue	640	0	640

Source: Based on Table 2.

FIGURE 8
Volume of fisheries production by country and base location of vessels, 2007 (tonnes)

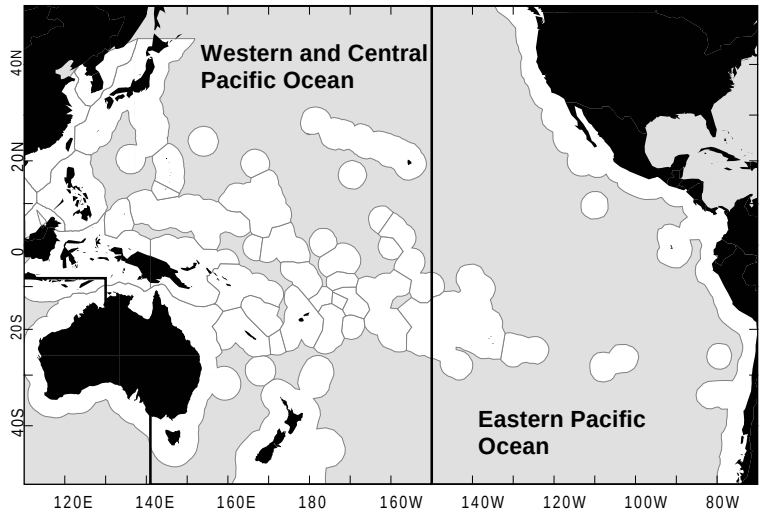


Source: Based on Table 2.

The WCPFC area catches

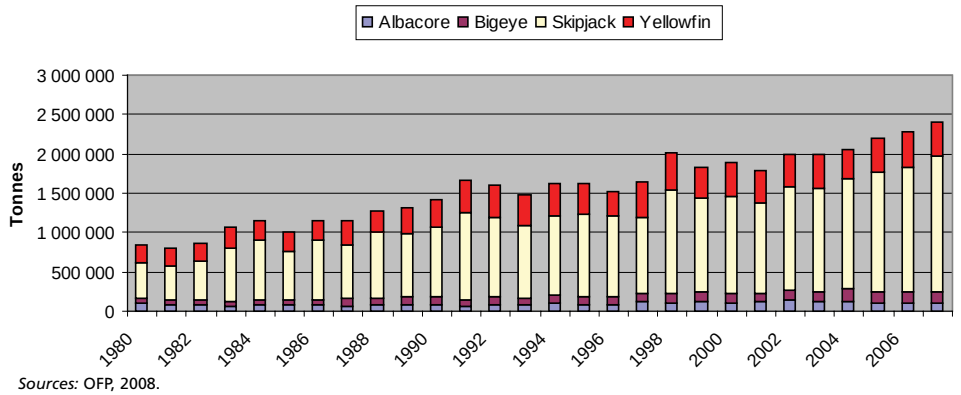
The above catch information is for the independent Pacific Island countries and their EEZs (Figure 1), which is a subset of the area covered by the WCPFC (Figure 9). The WCPFC area includes temperate waters to the north and south of Pacific Island countries, as well as parts of the waters of some Asian countries. In the Pacific Islands, the tuna resources and ways of tuna fishing (the subject of this paper) are somewhat different from those of the entire WCPFC area. For example, there is a huge tuna catch by small-scale gear in Indonesia, the catch of small tuna in the Philippines is substantial and a very large number of small longliners operate from Taiwan Province of China. Nevertheless, the available regional tuna catch statistics (i.e. data aggregated at a level higher than that of an individual country) are now compiled and presented for the entire WCPFC area.

FIGURE 9
Map of the WCPFC area



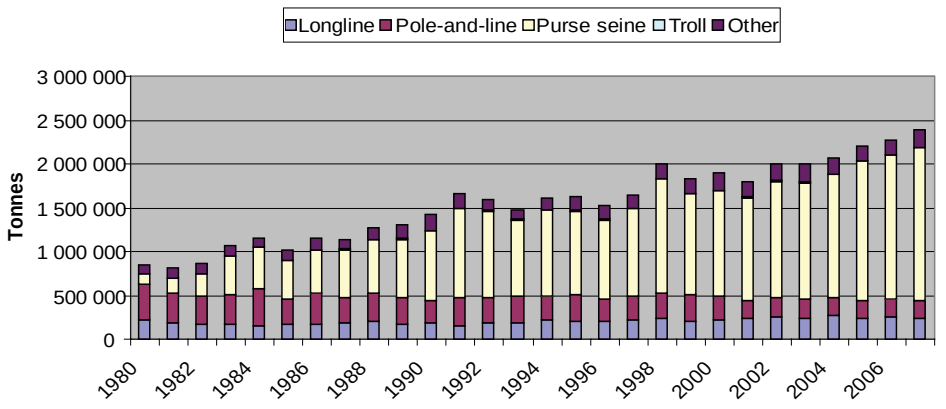
Source: Map courtesy of SPC.

FIGURE 10
WCPFC tuna catches by species, 1980–2006 (tonnes)



Sources: OFP, 2008.

FIGURE 11
WCPFC tuna catches by gear type, 1980–2006 (tonnes)



Sources: OFP, 2008.

Information in OFP (2008) can be graphed to show trends over the last three decades in catch by species (Figure 10) and by gear type (Figure 11).

From the above figures it can be seen that much of the tuna catch expansion in the WCPFC area is due to increased harvesting by purse-seine gear and increased harvesting of skipjack. Although bigeye catches have expanded much less that skipjack catches, they are a source of more concern due to the relatively small size of the bigeye resource in the region.

Williams and Terawasi (2008) comment on the 2007 tuna catches in the WCPFC area:

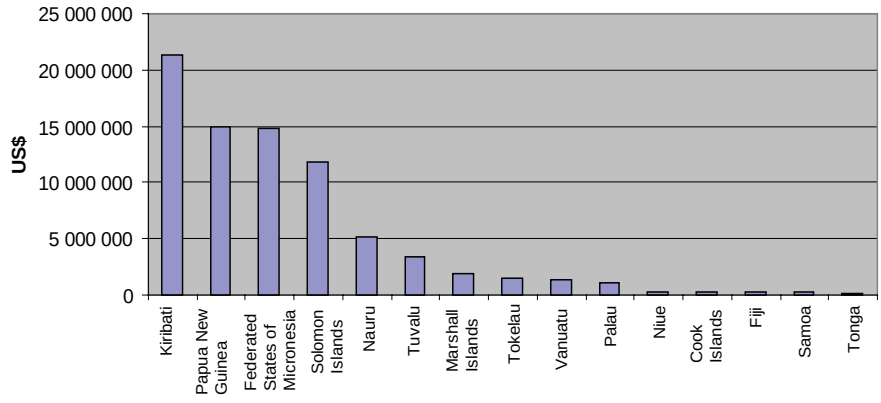
- The provisional total WCPFC area tuna catch in 2007 was estimated at 2 396 815 tonnes, clearly the highest annual catch recorded and more than 120 000 tonnes higher than the previous record in 2006 (2 273 322 tonnes).
- During 2007, the purse-seine fishery accounted for an estimated 1 739 859 tonnes (73 percent of the total catch and a record for this fishery), with pole-and-line taking an estimated 214 935 tonnes (9 percent of the total catch), the longline fishery taking an estimated 232 388 tonnes (10 percent of the total catch) and the remainder (8 percent of the total catch) taken by troll gear and a variety of artisanal gears, mostly in eastern Indonesia and the Philippines.
- The WCPFC tuna catch (2 396 815 tonnes) in 2007 represented 85 percent of the total Pacific Ocean catch of 2 800 740 tonnes and 55 percent of the global tuna catch.

SOME BENEFITS FROM OFFSHORE FISHING IN THE PACIFIC ISLANDS AREA

In the Pacific Islands, the coastal fisheries resources produce a significant amount of food and employment for the residents of the region. The offshore resources produce somewhat different types of benefits.

All Pacific Island countries received fees from foreign vessels for tuna fishing activity in their waters. ADB (2009) estimated that the total access fee payments for the countries of the region in 2007 were about US$77 million. Fees received by each country are shown in Figure 12. In some countries, the access fees form a very large portion of government revenue: Kiribati (42 percent of all government revenue in 2007), Nauru (17 percent of government revenue) and Tuvalu (11 percent of government revenue). Fees also are considerable relative to the population size: Nauru (US$518 per resident), Tuvalu (US$355 per resident) and Kiribati (US$288 per resident).

FIGURE 12
Access fees paid by foreign tuna vessels, 2007



Source: ADB, 2009.

A small change in the level of access fees can make a large difference in payments. According to ADB (2009), the value of the 2007 tuna catch in the region by foreign-based vessels was US$1.1 billion. A 1 percent increase in access fees as a proportion of the value of the offshore catch, therefore, represents an additional US$11 million in access fees.

The locally-based offshore fishing vessels employ substantial numbers of Pacific Islanders. A study by the FFA (Gillett, 2008c) estimated that in 2008 about 800 citizens of Pacific Island countries were employed on the 269 longliners, 56 purse seiners and 2 pole-and-line vessels based in the region.

STATUS OF THE EXPLOITED OFFSHORE FISHERY RESOURCES

The OFP of the SPC periodically assesses the condition of the four main species of tuna in the region. These assessments utilize all available information from the fishery, including catch, effort and size composition data for the main fisheries, as well as tagging data where available. Formal resource assessments were carried out in 2008 on albacore, bigeye and skipjack, while the last yellowfin assessment was in 2007.

The results of the SPC stock assessments are presented in various documents and discussed and debated at the annual Scientific Committee of the WCPFC where conclusions are reached. WCPFC (2008) summarizes the conclusions on the assessments *and gives the advice of the Scientific Committee as follows*.

Bigeye tuna

There is a very high probability that overfishing of bigeye tuna is occurring in the WCPO. While the stock is not yet in an overfished state with respect to total biomass, the situation is less optimistic with respect to adult biomass. Projections indicate that the stock will be overfished after 2013 with regards to both total biomass and spawning biomass. Recent catches are high relative to the estimated maximum sustainable yield (MSY), both because of high recent fishing mortality and because the stock has benefited from above-average recruitment over the past 15 years. *The Scientific Committee recommended a minimum 30 percent reduction in fishing mortality from the average levels for 2003–2006, with the goal of returning the fishing mortality rate to the rate at MSY. The reduction should occur throughout the WCPO from all major fishing types, with priority in the western equatorial region.*

Yellowfin tuna

There is a small probability (6.2 percent) that the yellowfin stock is in an overfished state. The composite longline fishery is responsible for biomass depletion of about 10 percent in the WCPO during recent years and generally catches larger, older size classes, while purse-seine fisheries are responsible for a larger percentage of the impacts and generally the catch is of smaller and younger fish. *In order to reduce the likelihood of overfishing and if the WCPFC wishes to maintain average biomass at levels greater than 5 percent above the biomass at MSY, there should be reductions in the fishing mortality rate.*

Skipjack tuna

The major conclusions of the skipjack assessment are essentially unchanged from the last three assessments (2002, 2003 and 2005): overfishing is not occurring and the stock is not in an overfished state. There is an increasing trend in estimated recruitment throughout the entire time series of the fishery. This trend may reflect skipjack tunas' high productivity relative to other tuna species, as well as its position in the ecosystem. Large recent catches are considered to be sustainable unless recruitment falls persistently below the long-term average. *Any increases in purse-seine catches of skipjack should be carefully monitored as they may result in a corresponding increase in fishing mortality for bigeye and yellowfin tunas.*

South Pacific albacore

The recent assessment indicates lower levels of stock size and MSY than previous assessments. There is uncertainty regarding the sustainability of the South Pacific

albacore stock. *Catches of South Pacific albacore should remain at current levels, considering the current rates of fishing mortality of adult albacore.*

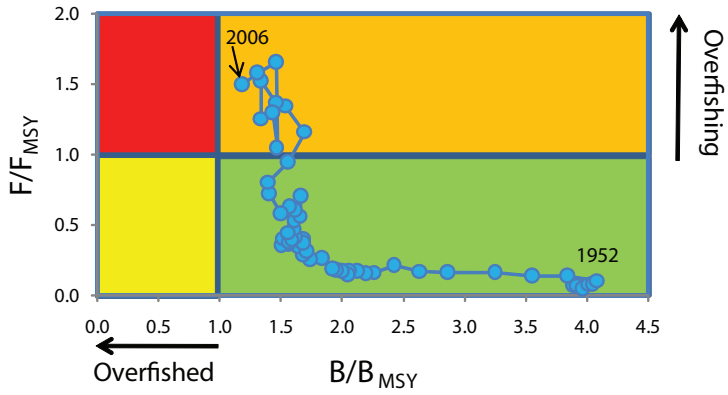
Swordfish

For swordfish in the *southwest* Pacific, overfishing is not occurring and the stock is not in an overfished state. The stock assessment attempted for swordfish in the *south-central* Pacific was unable to determine the current stock status – the available data do not indicate evidence of significant fishery impacts in the south-central Pacific but catches have increased in recent years to levels exceeding those in the southwest Pacific. *There should be no further increase in catch or effort in order to keep the stock above its associated reference points.*

From the above, it is obvious that the offshore fishery resource of the region currently most threatened by fishing pressure is bigeye. A detailed stock assessment for bigeye tuna was undertaken by SPC for the WCPFC in 2008. Figure 13 shows additional information on the status of bigeye from the SPC assessment. The assessment concluded that current exploitation levels were well above maximum safe levels, with almost certainty that overfishing is occurring. Significant reductions in fishing mortality are required to reduce the risk that the stock will be reduced to below the level that will support MSY.

FIGURE 13

SPC 2008 stock assessment of bigeye for the model period 1952–2006



Note: The temporal trend in annual stock status of bigeye tuna, relative to biomass (x-axis) and fishing mortality (y-axis) reference points, for the assessment model period (1952–2006). Current fishing mortality is well above the overfishing reference level and biomass is approaching overfished conditions.
Source: SPC, 2009a.

MANAGEMENT OF OFFSHORE FISHERY RESOURCES

The management of the offshore fishery resources in the Pacific Islands area is complex and involves political, resource and historical considerations. Current management occurs on the national, regional and international levels.

National-level management

A general feature of national-level tuna management in the region is the use of tuna management plans (TMPs). In 1998, the Canada-South Pacific Oceans Development Program cooperated with the FFA to produce a detailed TMPs for the Solomon Islands. FFA and Canada have subsequently prepared plans, on country request, for Palau, Vanuatu, Fiji and Kiribati. The ADB and Australia have also assisted in the formulation of TMPs for the Federated States of Micronesia and Samoa, respectively. FFA has continued with this process using its own staff and has prepared TMPs for Tonga, the Marshall Islands, Niue and Tokelau. Recently, New Zealand has provided fisheries assistance that includes support for TMPs in the Cook Islands and in the Solomon Islands.

Currently, all Pacific Island countries have prepared national TMPs and most plans have been formally adopted.

Characteristically, the TMPs give a description of the current national tuna fisheries, the status of the tuna resources (mostly from the work of SPC's OFP), overall government goals in the fisheries sector, specific objectives for the management of the fishery and the interventions used to obtain the objectives. Tuna resource sustainability is often given as the priority objective in the TMPs. Other objectives are related to increasing employment, increasing access fees and creating and/or enhancing domestic tuna fisheries.

As an example of a TMP, Box 10 gives the major elements of the Plan for the Management of Tuna in the Federated States of Micronesia.

Experience gained in studying the formulation and implementation of TMPs in the region indicates that TMPs have had their successes and disappointments. On a different level, these plans have had a major positive effect on many of the countries of the region. Although the planning process has not always been smooth, there have been substantial benefits. The first experience of some countries at formally establishing fisheries policies and articulating management goals has been during the process of formulating these plans. The plans have brought a degree of transparency to the fishery management process, which was somewhat nebulous in several countries.

The stable and reliable set of policy measures promoted by the plans are crucially important for attracting domestic and foreign investors to the fisheries sector. In some countries, the first government and industry consultative mechanisms in the fisheries sector are those established by the plans. The tuna planning process has resulted in a movement in some countries to develop management plans for the inshore fisheries.

Most Pacific Island countries are presently contemplating the modification of TMPs or formulation of entirely new plans.

Regional-level management

There are a number of regional tuna fishery management arrangements in the Pacific Islands. All arrangements are promoted and coordinated by the FFA. The first measures, introduced in the 1980s and early 1990s, were:

BOX 10

The Plan for the Management of Tuna in the Federated States of Micronesia (FSM)

The Plan for the Management of Tuna in the Federated States of Micronesia is a 53-page document with 13 sections mostly on management objectives and also a section on implementation, monitoring and amendment. The plan gives three overall management objectives: ensure that the nation's tuna resources are used in a sustainable way; obtain maximum sustainable economic benefits from the nation's tuna resources; and promote economic security for the nation through the use of tuna resources. The plan gives six specific objectives:

- ensure that the tuna catch does not exceed sustainable levels;
- obtain national revenue from foreign fishing access agreements;
- support development of FSM-owned and/or foreign FSM-based fishing enterprises;
- encourage investment in enterprises related to tuna fisheries;
- promote employment opportunities; and
- enhance international relationships beneficial to the Federated States of Micronesia.

The plan specifies mechanisms to be used to attain each objective.

Source: www.norma.fm

- as regards licensing foreign fishing vessels, agreement by countries to insist on the Harmonized Minimum Terms and Conditions for Foreign Fishing Vessel Access (MTCs, Box 11). These MTCs have been progressively added to over the years and now encompass several types of measures, such as the use of vessel monitoring systems (VMSs);
- reciprocal fisheries law enforcement as per the Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific Region; and
- incentives to local-basing for industrial tuna vessels as per the Federated States of Micronesia Arrangement for Regional Fisheries Access.

The region's first conservation-oriented management move in the tuna fisheries was the Palau Agreement for the Management of the Western Pacific Purse-Seine Fishery, which entered into force in November 1995. The agreement places a ceiling on the number of purse-seine licences that can be issued by the seven Pacific Island countries party to the agreement. The limit was originally set at 164 vessels and has been progressively increased. For several years, there has been discussion about modifying the Palau agreement so that purse-seine vessel fishing days rather than vessel numbers are used as the basis for management. In May

BOX 11

Minimum terms and conditions (MTCs) for foreign fishing vessel access

Pacific Island countries developed and implemented a set of Harmonized MTCs that apply to all foreign tuna fishing vessels seeking access to EEZs of the Pacific Island countries. Currently, the application of the MTCs is both widespread and comprehensive by Pacific Island countries in areas under their respective national jurisdictions. The MTCs provide to Pacific Island countries the following guidance in licensing foreign fishing vessels:

- a common regional licence form to be used for licensing;
- the conditions to be met for a licence: vessels must be in "good standing" on the Regional Register of Foreign Fishing Vessels and the Vessel Monitoring System Register of Foreign Fishing Vessels;
- monitoring and control of transshipments;
- maintenance and submission of prescribed forms reporting all catch and bycatch taken in EEZs and on the high seas;
- requirements pertaining to vessel reporting;
- observers and observer coverage;
- appointment of an agent in the relevant Pacific Island licensing country;
- requirements pertaining to stowing of gear by foreign fishing vessels when transiting fisheries zones;
- application of MTC in port and exercise of port state authority;
- enforcement cooperation;
- flag state or Fishermen's Associations Responsibility;
- requirement to implement a regional VMS;
- identification of FADs; and
- prefishing inspections.

Source: FFA, unpublished report.

2004, a subset of FFA member countries decided to adopt such a scheme and it has subsequently been progressively implemented.

In a general sense, the original thrust of regional tuna fishery management in the 1980s and 1990s was to increase foreign fishing access fees. This has been broadened in recent years to include domestic tuna industry development and resource sustainability. The latter objective overlaps somewhat with international fishery management efforts in the western and central Pacific Ocean.

International-level management

In the mid-1990s, there was a growing awareness of the need for a tuna management agency that would cover an area larger than the area encompassed by

BOX 12

Western and Central Pacific Fisheries Commission (WCPFC)

Complex negotiations between the coastal states of the western and central Pacific Ocean and distant-water fishing nations (DWFNs) led to the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. The objective of the convention is to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stocks in the western and central Pacific Ocean in accordance with the 1982 United Nations Convention on the Law of the Sea (UNCLOS) and the 1995 United Nations Fish Stocks Agreement. For this purpose, the convention establishes a Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. The contracting parties to the convention are members of the commission.

The convention applies to all species of highly migratory fish stocks except sauries. Conservation and management measures under the convention are to be applied throughout the range of the stocks, or to specific areas within the convention area, as determined by the commission. As of early 2009, participation in the commission consists of:

- Members: Australia, China, Canada, the Cook Islands, the European Community, the Federated States of Micronesia, Fiji, France, Japan, Kiribati, the Republic of Korea, the Republic of the Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, the Philippines, Samoa, the Solomon Islands, Chinese Taipei, Tonga, Tuvalu, the United States and Vanuatu.
- Participating territories: American Samoa, the Commonwealth of the Northern Mariana Islands, French Polynesia, Guam, New Caledonia, Tokelau, and Wallis and Futuna.
- Cooperating non-members: Belize, Indonesia, Senegal, Mexico and El Salvador.

Source: The WCPFC Web site www.wcpfc.int

Pacific Island countries and would include countries that have vessels fishing in the area, such as Japan and the United States. After years of discussions among the coastal states of the western and central Pacific Ocean and the states fishing in the region, a management convention came into force in June 2004. Box 12 provides some details about the commission established by the convention.

The commission, which has its secretariat headquarters in Pohnpei, has been operational for over five years and five annual meetings of the commission have been held. There are subsidiary bodies of the WCPFC, including the Scientific Committee and the Technical and Compliance Committee, which also have annual meetings.

The commission adopts "resolutions" which are non-binding statements and "conservation and management measures" (CCMs), which are binding. As of mid-2009, a total of 26 CCMs have come into force.[6]

Much of the hope for the sustainability of the tuna resources of the WCPO is focused on the commission. Some Pacific Island countries are growing uncomfortable at what they perceive as non-cooperation by a few of the larger fishing nations to agree to management initiatives. Langley *et al.* (2009) chronicle the increasing concern over the last two decades about the condition of bigeye and yellowfin resources and the concurrent increase in fishing effort for these species. There is the view that the effectiveness of the commission is being undermined by some DWFNs.

In the commission meeting of December 2008, a crucial CCM was adopted – which may increase the effectiveness of the WCPFC in its tuna management efforts. The objectives of that measure (CCM 2008-06) are:

- to implement a package of measures that, over a three-year period commencing in 2009, results in a minimum of 30 percent reduction in bigeye tuna fishing mortality from the annual average during the period 2001–2004 or in 2004;
- to ensure that there is no increase in fishing mortality for yellowfin tuna beyond the annual average during the period 2001–2004 or in 2004; and
- to adopt a package of measures that shall be reviewed annually and adjusted as necessary by the commission, taking account of the scientific advice available at the time as well as the implementation of the measures.

Other resource management measures of the WCPFC deal with seabirds, swordfish, striped marlin and sharks.

The relationship between management of the offshore resource at the regional and international levels is complex. To some degree, international management encompasses objectives that are common to its members and are for the most part objectives that relate to resource sustainability. For some other objectives, such as maximizing government revenue from foreign fishing or encouraging the basing of vessels in the region, the interests of Pacific Island countries may be very different from those of DWFNs. They are the types of objectives where regional management coordinated by FFA has an important role.

SOME IMPORTANT ISSUES RELATING TO OFFSHORE FISHERY RESOURCES AND THEIR MANAGEMENT

With respect to offshore fishery resources, without doubt the most important issue is overexploitation of bigeye, and to a somewhat lesser degree, of yellowfin. The gravity of the situation is emphasized by the topic being taken up at the highest political level in the region. A recent meeting of the Pacific Islands Forum (heads of state and government) took the unprecedented step of making a declaration on the issue:

[6] Eight of the older CCMs have been replaced by more recent CCMs.

"…Seized the scientific advice that overfishing of two key regional tuna species – bigeye and yellowfin tuna – now places stock levels in jeopardy,…we commit ourselves and our governments to the conservation and sustainable management of highly migratory tuna resources by:

- Fully implementing without delay the conservation and management measures developed and endorsed by the WCPFC.
- Seeking the urgent adoption of additional measures by the WCPFC to address overfishing of bigeye and yellowfin, including a reduction in longline catches and addressing purse-seine fishing, and specific steps to reduce the catch of juvenile bigeye and yellowfin."

The reduction of fishing effort for bigeye and yellowfin raises some interesting management issues:

- Many DWFNs are very reluctant to embrace more restrictive controls on effort and catch – which leads to the contention that effectiveness of the WCPFC is being undermined by some DWFNs.
- Reductions in bigeye and yellowfin mortality are possible through controls on purse-seine fishing efforts and controls on longline fishing efforts. These two types of controls are causing some degree of polarization between Pacific Island countries that receive substantial benefits from purse seining and countries (mainly those countries in the non-equatorial region) that are not involved with purse seining but rather have locally-based longliners.
- Although the skipjack resource holds the most potential for tuna catch expansion, Pacific Island countries have difficulty taking advantage of this potential because the only viable industrial harvesting technique is purse seining – which also catches yellowfin and (when fishing around FADs) bigeye.

Another important offshore resource issue concerns bycatch. The amounts and type of non-target fish species caught during tuna fishing in the Pacific Islands vary depending upon the type of fishing gear used. SPC studies show that in the purse-seine fishery, from 0.35 to 0.77 percent of the total catch from fishing on tuna schools not associated with floating objects is bycatch. For sets on tuna aggregating around floating objects, the total catch is higher at an estimated 3.0–7.3 percent. The most common bycatch species observed in floating object sets are amberjack (*Seriola rivoliana*), mackerel scad (*Decapterus macarellus*), rainbow runner (*Elagatis bipinnulata*), drummer (*Kyphosus cinerascens*), mahimahi (*Coryphaena hippurus*) and ocean triggerfish (*Canthidermis maculatus)*. In the longline fishery, over 50 non-target fish species have been observed in the catch in the tropical and subtropical waters of the WCPO. The SPC study had insufficient data to estimate relative quantities. The non-target fish species can be categorized into shark (21 species), non-target tuna (7 species), billfish (6 species) and other fish (21 species). The blue shark (*Prionace glauca*) was observed as the most common shark species taken throughout the WCPO.

Many of the interesting issues associated with tuna bycatch are related to measures to reduce bycatch. These measures include gear and area restrictions,

strategies for live release and special measures for swordfish fishing. There is also the possibility of trade restrictions relating to bycatch by the major importing nations.

Other important offshore resource issues are:

- Climate change. Alterations in ocean temperatures and currents, and the food chains in the open ocean, are projected to affect the future location and abundance of tuna species in the Pacific Islands region. Initial modelling indicates that the concentrations of skipjack and bigeye tuna are likely to be located further to the east than in the past. The simulations have yet to be done for yellowfin and albacore (Bell, 2009).
- Recent stock assessment work shows that tuna fishing in Indonesia and the Philippines are having a large impact on the stocks in the WCPO region. SPC studies show that the Indonesian fishery is a large contributor to the depletion of WCPO yellowfin stock. Much of the tuna captured in Indonesia and the Philippines is taken with very small-scale gear and consequently it is difficult to place controls on that type of fishing. Even if Pacific Island countries put considerable effort into establishing national and regional tuna management regimes, those regimes may be undermined by the unmanaged tuna fisheries in Indonesia and the Philippines.

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This document updates and expands an earlier review by FAO of the marine fishery resources of the Pacific Islands. The Pacific Islands region consists of 14 independent countries and 8 territories located in the western and central Pacific Ocean. The region's fishery resources can be broadly split into two main categories: oceanic (offshore) and coastal (inshore). Oceanic or offshore resources include tunas, billfish and allied species. They are characterized by an open-water pelagic habitat and potentially extensive individual movements. Coastal or inshore resources include a wide range of finfish and invertebrates. They are characterized by their shallow-water habitats or demersal life-styles and restriction of individual movements to coastal areas. This paper discusses these two resource categories. Information is provided on the major types of fishing, the important species, the status of those resources and the fisheries management that occurs.

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