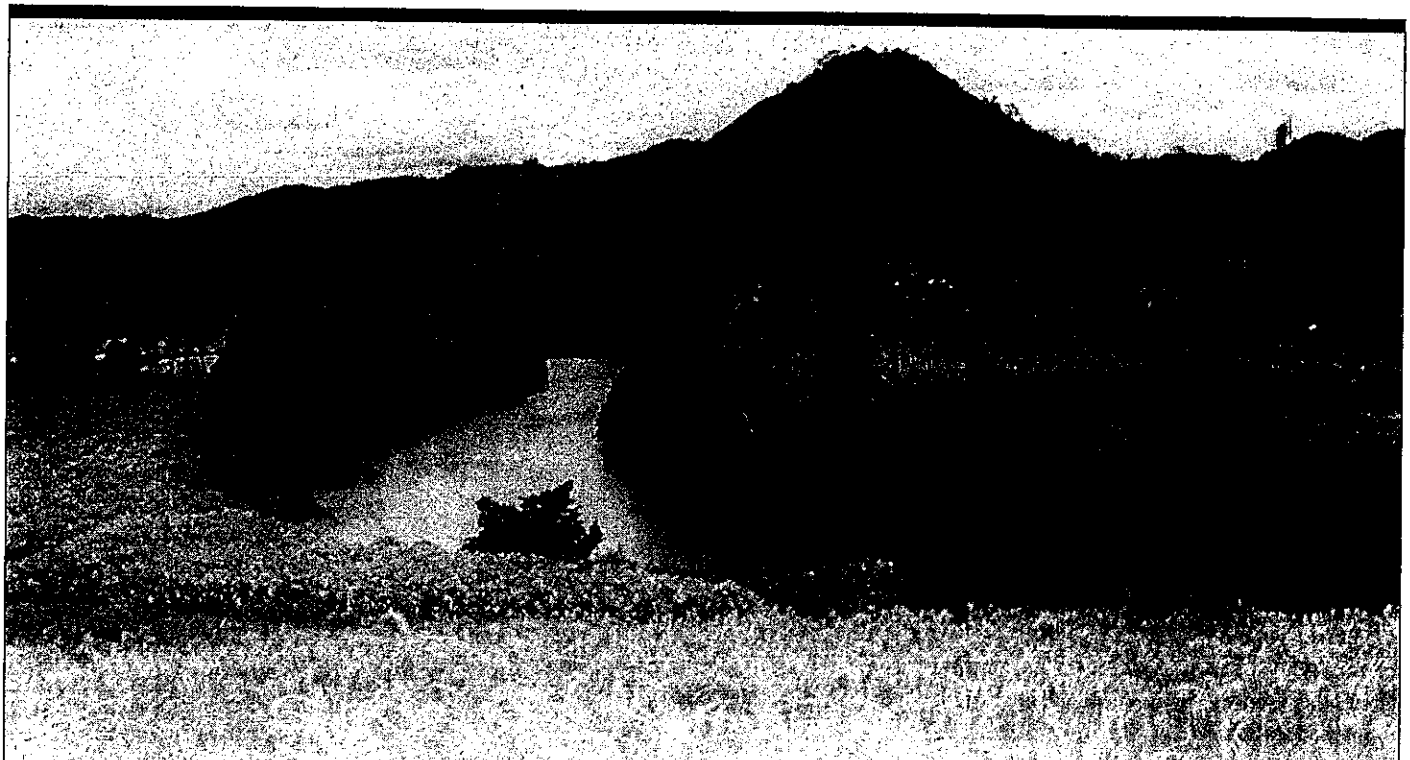

THE PACIFIC ISLANDS

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Moshe Rapaport

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CONTENTS

Ocean Resources

Vina Ram-Bidesi

30

The twenty-two developing states and territories of the Pacific Islands region consist of only about 551,390 km² of land with about 9.5 million people spread across 30 million km² of ocean (as shown in Figure 30.1). The region therefore comprises mainly ocean, which accounts for 98 percent of the total area and extends thousands of kilometers from north to south of the equator. The islands are linked and controlled by the oceanic environment.

The dependence of the Pacific Island countries upon the ocean resources has been a vital part of their cultural, social, and economic development. The coastal and marine ecosystems of the region are extremely important habitats for sustaining the livelihoods by providing food and nutritional security. With limited arable land and poor soils in the low-lying islands, the reliance on marine resources is extremely important. As the population increases, this dependence becomes even more critical. The ocean is seen as the "lifeline" that "provides the greatest opportunities for economic development" (SPREP 2002). Economic activities such as fisheries, tourism, and trade are highly dependent on the marine environment. On the other hand, the economies and environments of many of the island countries are extremely fragile not only in relation to the global economy but also because of their vulnerability to a wide range of environmental factors. Natural disasters such as cyclones, floods, drought, increasing amounts of waste and pollution, and overexploitation of resources pose major threats to realizing the ocean's potential.

This chapter will consider Pacific Island ocean resources according to their distinctive uses and will highlight some threats and challenges to the future sustainability of these valued resources.

Ocean Environments

Marine ecosystems include those that are associated with seafloor, known as benthic, and those that are in open water, called planktonic and/or pelagic. The major abiotic factor within these marine ecosystems is light, which distinguishes shallow ecosystems (coral reefs in the tropics) from deep-water ecosystems (Lobban and Schefter 1997). The harvestable productivity is largely dependent on the rich upwelling systems of the continental margins of the ocean. Most of the islands rise steeply from the deep ocean floor and have little shelf area, with the exception of Papua New Guinea and New Zealand. As a result, most Pacific Island countries lack the broad shallow shelves characteristic of continental margins and major island archipelagoes like those found in Southeast Asia and the Caribbean. It is common to find depths of 3,000 m within 2 km of shore (Adams, Dalzell, and Ledua 1999). Coral reefs characteristically surround the islands either close to shore (fringing reefs) or further offshore (barrier reefs), in which case a coastal lagoon is enclosed. Mangrove forests often border the inshore waters, especially around the larger islands, and provide habitat for the juveniles of many important food fish.

Coral dominates the nearshore substrate of geologically young island groups like Hawai'i, the Marquesas, Vanuatu, and the Northern Marianas where reef building hermatypic coral structures are not well developed and barrier reefs uncommon.

A primary feature of the central equatorial Pacific is a strong divergent equatorial upwelling called the cold tongue, which is favorable to the development of a large zonal band with high levels of primary production (Lehodey 2001). Contiguous to the cold tongue is the western Pacific warm pool, characterized by warmer water with lower levels of primary productivity.

Despite its low primary productivity rates, the western equatorial Pacific warm pool supplies the largest proportion of tuna catch in the Pacific Ocean and contributes approximately 40 percent of the world's annual tuna supply (Lehodey 2001: 441). The pool's boundaries are dynamic, moving in response to oceanographic features. The warm pool can undergo spectacular displacements of more than 40° of longitude (nearly 4,000 km) in less than six months as part of the El Niño/La Niña phenomenon (Lehodey 1997). Tuna abundance and yields are displaced east-west by the same phenomena. The geographic locations of catches of purse seine fleet can be predicted in advance based on the east-west movement of the 29° C isotherm and variation in the Southern Oscillation Index (a measure of the difference in barometric pressure between the eastern and western Pacific Rim) (Lehodey 1997).

In contrast to animal populations that are dispersed in the open ocean, tropical reefs are highly productive. Many Pacific islands are surrounded by barrier reefs, almost all have fringing reefs, and the surface area of some islands consists entirely of reefs in the form of atolls (Adams, Dalzell, and Ledua 1999: 367). Coral reefs are home to more than a quarter of all known marine fish species and have been termed the "rainforests of the marine world" (Bryant et al. 1998; United Nations 2000: 103). Coral reef

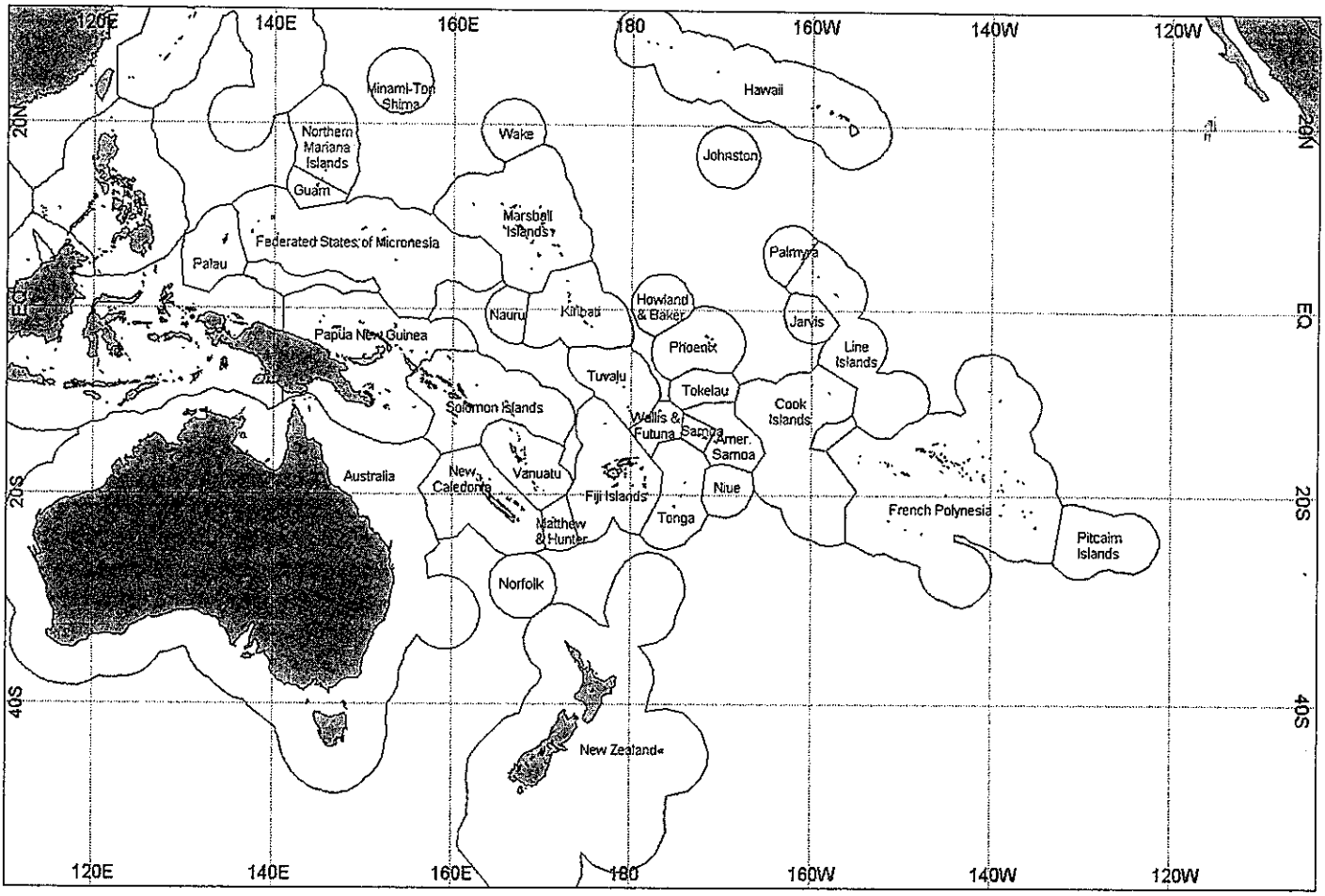

Figure 30.1. Pacific Island 200-mile zones (SPC n.d.).

systems provide a useful indicator of marine biodiversity and ecological health. About 40 percent of global coral reefs are found in the Pacific region (United Nations 2000: 103). Barrier reefs around New Caledonia, the Western Province in Solomon Islands, the Great Astrolabe, and Great Sea Reef in Fiji are examples of areas of high species diversity. The extensive coral reefs of the Pacific Islands consist of seventy coral genera supporting more than four thousand fish species, thirty mangrove species, and a range of reptiles, marine mammals, and seabirds (SPC 2008b: 1).

Mangroves are important habitats in the coastal areas of the western Pacific, although mangroves are not found naturally eastward of Samoa, in line with the general decline in natural species biodiversity from west to east across the Pacific (Adams, Dalzell, and Ledua 1999). The South Pacific subregion provides about two million hectares of mangroves or about 10 percent of the total mangrove areas in the world (United Nations 2000: 102).

Seagrasses are common features of shallow marine ecosystems and, like mangroves, are particularly significant as "nursery habitat" for the juveniles of many of the living resources that are important food sources for humans. The generic richness of seagrass beds is centered in the Indo–West Pacific region, while species diversity is highest in the area defined by Indonesia, Borneo, Papua New Guinea, and Northern Australia (United Nations 2000: 103). In the western Pacific, seagrass beds exist due to the sheltering effect of the extensive barrier reefs.

Direct and Indirect Uses of the Ocean Resources

Pacific Ocean resources have direct and indirect uses and can be either extractive or nonextractive. Resources can also be categorized as living, such as fish and marine plants, or non-living, such as oil, gas, and minerals.

Fisheries Resources

Fisheries resources discussed are either coastal or offshore. While the major emphasis is on developing smaller island countries of the Pacific, a brief note will be made on the more developed fisheries of New Zealand and Hawai'i, where the scale of operations and management systems is similar to fisheries in developed countries. In New Zealand, the value of harvests from wild fisheries ranges from $1.2 to $1.5 billion per annum, of which aquaculture contributes about $200 million per annum (New Zealand Ministry of Fisheries 2008). Seventy percent of the fish is taken from deep water, and management of most important commercial fisheries is under the quota management system. For example, there are 129 species separated into 96 groupings that are managed under the quota management system, with an estimated quota value of NZ$3.8 billion (New Zealand Ministry of Fisheries 2008). Likewise in Hawai'i, fisheries are predominantly commercial, having a varied fishing fleet that targets offshore tuna and pelagic and bottom

fishes. The scale of commercialization can be seen, for example, from a report that stated that nine bottom fishers in the northern Hawaiian Islands fishing in federal waters brought in a catch worth around US$1.5 million each per annum (McAvoy 2005).

Coastal Fisheries

In most Pacific islands, coastal fisheries are characterized as artisanal and subsistence fishing carried out in the lagoons, on the mud flats, reefs and outer shelves, and in offshore areas extending to a distance where small vessels can operate. The dispersed nature of the islands, the informal types of fishing activities, and the limited resources of governments makes any assessment of the coastal fisheries difficult. The production estimates are typically guess estimates produced by agricultural censuses, household surveys, ór nutritional statistics (Visser 1997). While recent estimates are almost nonexistent, some figures have been available from the mid-1990s for subsistence fisheries. Estimates of annual nominal per capita fish consumption based on domestic fish production and population figures range from 7 to 40 kg or a mean of 23 kg for Melanesia, while in Polynesia and Micronesia, the ranges are 6 to 121 kg and 4 to 170 kg with means of 60 and 63 kg, respectively (Dalzell, Adams, and Polunin 1996). According to FAO data, fish (of which the vast majority is from coastal areas) represents 38.7 percent of the total animal protein intake in the Pacific Islands region, much greater than the world average of 16.1 percent (FAO 2005). Table 30.1 shows the relative importance of coastal fisheries in the Pacific Islands in terms of catch per capita.

Estimates show that as much as 83 percent of the coastal households of Solomon Islands, 35 percent of the rural households of Vanuatu, 99 percent of the rural households of Kiribati, 87 percent of the households in the Marshall Islands, and half the rural households in Upolu Samoa fish primarily for local consumption (World Bank 1995). Besides providing a source of food and nutritional security, subsistence fisheries also play an important role in national economies through import substitution. It is further estimated that some Pacific Island countries would have to spend an additional US$7 to 18 million a year for imported protein substitutes if subsistence fisheries did not exist (World Bank 1995). According to a report in 2000, the value of annual subsistence production of finfish and shellfish in protein equivalent was US$6.7 million in Fiji, US$18 million in Kiribati, US$13.9 million

Table 30.1

The Relative Importance of Coastal Fisheries in the Pacific Islands

Country	Land area (km²)	EEZ area (km²)	EEZ area/ land area	Population	GDP/capita (US $)	Total coastal fish (tonnes)	Coastal fish catch/capita (kg)
Am. Samoa	199	390,000	1,959.8	66,107	6,995	267	4.0
Cook Islands	237	1,830,000	7,721.5	15,537	8,553	875	56.3
FSM	701	2,978,000	4,248.2	110,443	2,183	10,000	90.5
Fiji	18,272	1,290,000	70.6	839,324	3,175	30,920	36.8
Guam	541	218,000	403.0	178,980	22,661	590	3.3
Hawai'i (USA)	16,641	2,381,000	143.1	1,262,840	49,563	13,424	10.6
Kiribati	811	3,550,000	4,377.3	97,231	653	16,000	164.6
Marshall Is.	181	2,131,000	11,733.5	53,236	2,851	3,244	60.9
Nauru	21	320,000	15,238.1	10,163	2,807	425	41.8
Niue	259	390,000	1,505.8	1,549	5,828	206	133.0
CNMI	457	1,823,000	3,989.1	62,969	12,638	2,966	47.1
N. Caledonia	18,576	1,740,000	93.7	246,614	29,898	3,481	14.1
Palau	444	629,000	1,416.7	20,279	8,423	2,115	104.3
PNG	462,840	3,120,000	6.7	6,473,910	991	31,500	4.9
Pitcairn Is.	5	800,000	160,000	66	-	8	121.2
Fr. Polynesia	3,521	5,030,000	1,428.5	263,267	22,472	6,043	23.0
Samoa	2,935	120,000	40.9	179,645	2,872	7,169	39.9
Solomon Is.	28,370	1,340,000	47.2	517,455	753	16,200	31.3
Tokelau	12	290,000	24,166.7	1,170	-	191	163.2
Tonga	650	700,000	1,076.9	102,724	2,319	7,036	68.5
Tuvalu	26	900,000	34,615.4	9,729	1,831	1,100	113.1
Vanuatu	12,190	680,000	55.8	233,026	2,127	2,930	12.6
Wallis & Futuna	142	300,000	2,112.7	15,472	-	917	59.3

Source: Adams et. al (1999); (FAO) 2005; Gillett & Lightfoot (2001); Gillett (2009); Gillett (2011); SPC 2008; http://www.st.nmfs.noaa.gov/st1/fus/fus09/02_commercial2009.pdf; http://hawaii.gov./dbedt/info/economic/databook/2008-individual/ 2008.

in Solomon Islands, and US$14.7 million in Vanuatu (World Bank 2000). In Papua New Guinea, the catch of subsistence coastal fisheries was estimated to be around 26,000 tonnes (mt) per year with a sale value of 60 million kina and the catch of artisanal/commercial coastal fisheries at 5,500 mt/year. Estimates indicated that 250,000 people participated in coastal subsistence fisheries (Gillett Preston and Associates 2000). Of the rural households engaged in fishing, 60 percent were subsistence fishers. The estimated subsistence production in Fiji in 2002 was 18,400 mt with a value of US$7.1 million, or an import substitution value of US$9.2 million (Fiji Fisheries Department 2005). Artisanal catch of 6,871 mt in the local market was valued at F$26.6 million while exports of inshore fisheries was valued at F$26 million, consisting largely of aquarium products (Fiji Fisheries Department 2005).

A more recent study attempted to value the contribution of small-scale nonpelagic fisheries to GDP in two American territories (American Samoa and Northern Marianas) by reconstructing the production and consumption patterns based on earlier estimates. The study concluded that between 1982 and 2002, the small-scale nonpelagic fisheries alone may have contributed approximately US$54.7 million to the GDP of American Samoa and Northern Mariana Islands (Zeller, Booth, and Pauly 2007). This was 5.1 times the value of subsistence assessed by official statistics.

Table 30.2 shows the annual volume and value of commercial and subsistence production of coastal fisheries. The table indicates that the value and volume of subsistence catch far outweighs the commercial coastal catch. The value of subsistence fisheries to food security can be gauged by how much Pacific Island governments would have to pay for imported substitutes if these fisheries ceased to exist. An interesting feature of this fishery is that the most active fishers are generally women, children, and youth.

Subsistence fishing also plays a significant social role in the Pacific communities as fishing activities have been interwoven into the daily lives of people for generations. Subsistence fishing, commonly regulated by local custom, contributes to preservation of cultural traditions and helps maintain social cohesion of coastal communities.

Pacific Island countries do not export many varieties of coastal fisheries products. The principal exports include dried sea cucumber (bêche-de-mer), trochus, pearls and aquarium fish, coral, and live rock and seaweeds, most of which are targeted at specific niche markets.

Table 30.2

Annual Volume and Value of Commercial and Subsistence Coastal Fisheries

Country	Coastal commercial (t)	Coastal commercial ($)	Coastal subsistence (t)	Coastal subsistence ($)
American Samoa	35	166,000	120	478,000
Cook Islands	133	1,029,412	267	1,250,000
Federated States of Micronesia	2,800	7,560,000	9,800	15,732,000
Fiji	9,500	33,750,000	17,400	33,812,500
French Polynesia	4,002	23,004,598	2,880	13,208,276
Guam	44	195,000	70	217,000
Kiribati	7,000	18,487,395	13,700	28,571,429
Marshall Islands	950	2,900,000	2,800	4,312,000
Niue	10	58,824	140	617,647
Nauru	200	840,336	450	661,345
New Caledonia	1,350	8,689,655	3,500	15,770,115
Northern Marianas	231	950,000	220	631,700
Palau	865	2,843,000	1,250	2,511,000
Papua New Guinea	5,700	27,027,027	30,000	35,472,973
Pitcairn Islands	5	37,500	7	36,765
Samoa	4,129	19,557,592	4,495	14,903,842
Solomon Islands	3,250	3,307,190	15,000	10,980,392
Tokelau	0	0	375	711,397
Tonga	3,700	11,287,129	2,800	6,182,178
Tuvalu	226	616,526	989	2,232,686
Vanuatu	538	2,176,923	2,830	5,740,385
Wallis & Futuna	121	1,206,897	840	6,333,333
TOTAL	44,789	165,691,002	109,933	200,366,961

Source: Gillett 2009.

Dried sea cucumber exports date back to the early days of European contact and is found throughout the tropical Pacific. About thirty-six species of sea cucumbers (Holothuroidea) are currently exploited in the region, primarily for export to Asia. Villagers can process sea cucumber into a nonperishable product that can be stored for extended periods until transport becomes available (Foale 2008). Figure 30.2 shows the drying of bêche-de-mer destined for export. The fishery is characterized by a boom-and-bust cycle of intense exploitation followed by a sharp fall in the abundance, then a dormant period in which the resource is able to recover. For example, in Papua New Guinea, Solomon Islands, and Fiji, production increased in the late 1980s and early 1990s but declined due to overfishing by use of underwater fishing gear and equipment.

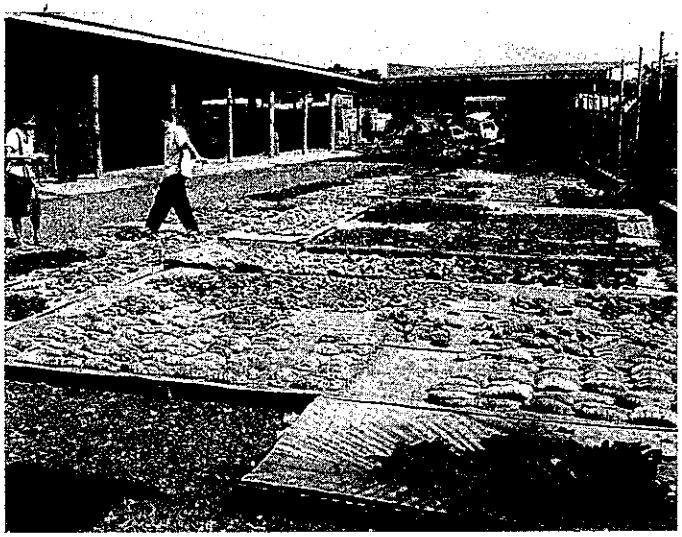

Figure 30.2. Drying of sea cucumber (photo VRB).

Although the natural range of *Trochus niloticus* is limited to the western part of the Pacific, it has been transplanted to almost all Pacific Island countries. The annual harvest of *Trochus niloticus* in the region in recent years has been estimated at 2,300 metric tons with an export value of about US$15 million (FAO 2005). It is an important fishery because it requires low technology and equipment and because shells may be stored for long periods prior to shipment to market. In several remote Pacific Island countries, trochus provides an important source of cash income at the village level, especially since the demise of the copra industry. In Fiji, trochus is semiprocessed into button blanks, which not only adds value but also reduces the transport costs considerably. On the island of Aiututaki in the Cook Islands, trochus harvesting is managed through a quota system that allows harvesting for a limited number of days within a year.

In most of the Pacific Islands, finfish found in relatively shallow water (<50 m) are the basis of much of the commercial fisheries. About three hundred species representing thirty to fifty fish families make up the majority of the catch (FAO 2005). Yields in the region have been estimated to be between 5 and 50 kg per hectare per year (Wright and Hill 1993). Commercial export of shallow-water reef fish is not a major industry; most of the overseas shipments of these fish are in the form of passenger baggage by Pacific Islanders during visits to Guam, Hawai'i, Australia, and New Zealand.

Snappers and groupers are found on slopes of one to four hundred meters depth of most Pacific islands. Because they receive a high price in overseas markets, deep-slope snappers and groupers have been the subject of considerable interest in the 1970s and 1980s. One of the major objectives was to ease fishing pressure in the inshore areas by diverting fishing efforts to outer reef slopes. The aggregating nature of the fish stocks, however, led to their increased vulnerability to fishing pressure on the seamounts, consequently reducing the scale of fishing in the region.

Another valuable export product that is gaining much attention is black lip pearl shells (*Pinctada margaritifera*), cultivated primarily from wild stocks. In the wild they are found attached to coral reefs in depths of five to sixty meters. In the past, divers collected the pearl oysters, and the shells (mother-of-pearl) were exported to be made into products such as buttons. But these days, black-lipped oysters are more valuable if kept alive and cultured for their black pearls.

Black pearls are a major contributor of foreign exchange in the Cook Islands and French Polynesia, and they also contribute to export revenue in Fiji. The Marshall Islands, Solomon Islands, and Tonga are currently involved in trial operations. In the Cook Islands in 2007, there were about 110 pearl farms on Manihiki, and 1.5 million adult oysters were being cultured (SPC 2008c). On Penrhyn there were about 100 pearl farms and about 200,000 cultured oysters, with annual production valued at NZ$5 million. The true figures, however, may be much higher; the Ministry of Marine Resources estimated that it is probably more than NZ$10 million (SPC 2008c). Black pearls account for about 85 percent of the export industry, and the economic value of the industry is second only to tourism.

Aquarium fish collectors target a large number of species, with the major families being butterfly fish (Chaetodontidae), damselfish (Pomacentridae), surgeonfish (Acanthuridae), and angelfish (Pomacanthidae). The relatively recently established aquarium fish industries in Kiribati and the Marshall Islands account for 78 percent and 95 percent of all fishery exports from those countries respectively. Aquarium trade exports from Solomon Islands accounts for about 4 percent of the total international coral trade (Lal and Kinch 2005: 6). Almost seventy species of live coral are regularly exported from Solomon Islands, together with nineteen species of dead coral (Lal and Kinch 2005: 9). Maintaining the quality is of utmost importance for fetching the optimum price. Figure 30.3 shows the special packaging boxes for aquarium fish and live corals.

While seafood remains an important source of protein for the Pacific Islands, catches of many important species that are easily accessible have been declining in some islands over the years. In the few islands where data is collected continuously, the recorded decline has sometimes been dramatic. In Guam, for example, catch rates have been reduced by 70 percent over the past 15 years (King et al 2003: 1). The major reasons for decline include overexploitation, shift from subsistence to commercial fishing, use of overly efficient and destructive methods, and environmental degradation (King et al. 2003: 1).

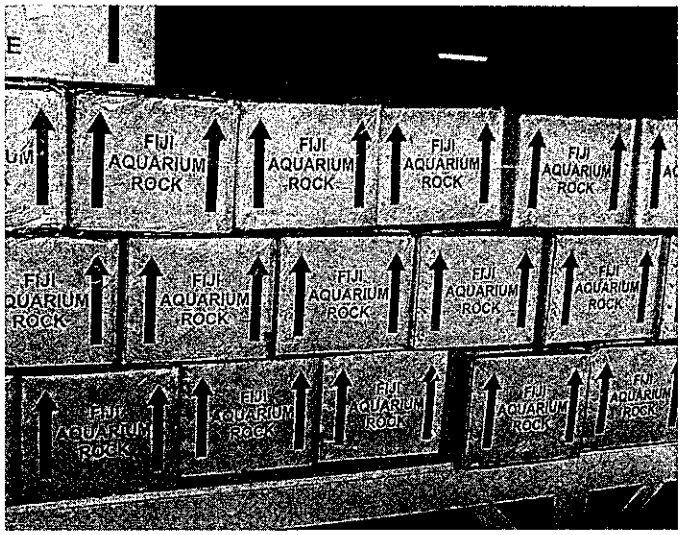

Figure 30.3. The special packaging materials required to ensure that quality is maintained (photo VRB).

Offshore

For centuries, tuna has provided an important source of food for Pacific Island people and has shaped their rich maritime culture. The fishery ranges from small-scale artisanal operations in the coastal areas to large-scale industrial purse seine, longline, and pole-and-line operations in the exclusive economic zones (EEZs) of Pacific Island countries and on the high seas. It is estimated that the Western and Central Pacific region meets about 60 percent of global tuna demand for canning and 30 percent of the tuna for the high-value Japanese sashimi market and is ranked as having the largest tuna resource in the world (Gillett et al. 2001). Figure 30.4 distinguishes the western Central Pacific from the eastern Central Pacific (SPC 2011).

The economic importance of tuna to the Pacific Islands region has been highlighted in a number of studies (Gillett et al. 2001; Gillett and Lightfoot, 2001; Ram-Bidesi 2003; Reid 2006). Tuna provides an important source of employment, income, and source of foreign exchange to island economies. Access revenue from foreign fishing vessels is also an important source of government revenue for a number of smaller island countries such as Kiribati, Tuvalu, the Marshall Islands, and the Federated States of Micronesia. Tuna is a major export commodity for countries that have established shore-based processing such as Fiji, Solomon Islands, Papua New Guinea, and American Samoa. Direct employment in the tuna industry includes crewing opportunities, shore-based processing, and administration and management work, while indirect employment includes port services, research, and monitoring and surveillance activities. Indirect employment is also created in related industries such as gear manufacture, fuel, food, hotel, and hospitality. The more labor-intensive the activities are, the more spin-offs are likely to arise. To create greater employment opportunities, many of the Pacific Island countries over the years have formulated development policies that aim to increase benefits to the local economy from the tuna resources.

In 2007, the total annual catch in the Western and Central Pacific was approximately 2.4 million tonnes, with a catch value of US$3.8 billion, which accounted for 55 percent of the total global tuna catch (Hampton 2008). Figure 30.5 shows the catch trends. Total annual catches increased steadily during the 1980s through the expansion of the purse seine fleet, followed by a relatively stable period in the 1990s and again with increase in catches.

The purse seine fishery contributed 1,818,255 mt (75 percent) of the total catch, while pole-and-line methods contributed 171,597 mt (7 percent), longline fishing 248,589 mt (10 percent) and remaining 7 percent by troll gear and artisanal gears (SPC 2011: 95). The four main target species are skipjack tuna (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*), bigeye (*T. obesus*), and albacore (*T. alalunga*). Table 30.3 shows catch by gear type, while Table 30.4 shows the catch by species. The purse seine fishery targets skipjack but also records significant amounts of juvenile yellowfin and bigeye. The longline fishery targets adult bigeye, yellowfin, and albacore, whereas the target species for pole-and-line fishing is skipjack.

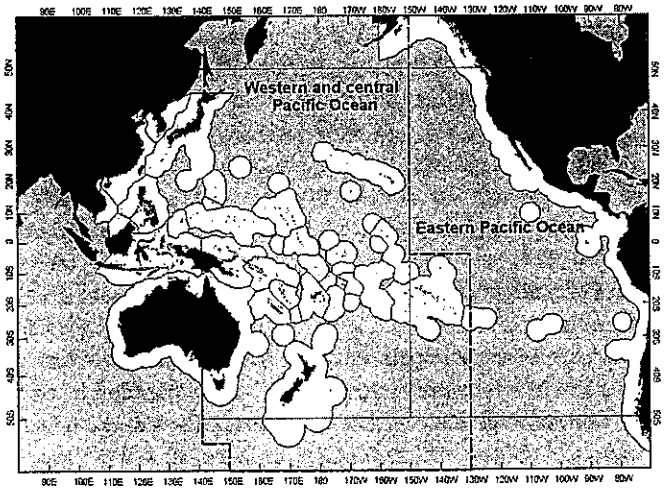

Figure 30.4. The boundaries of the Western and Central Pacific Ocean Area (SPC n.d.).

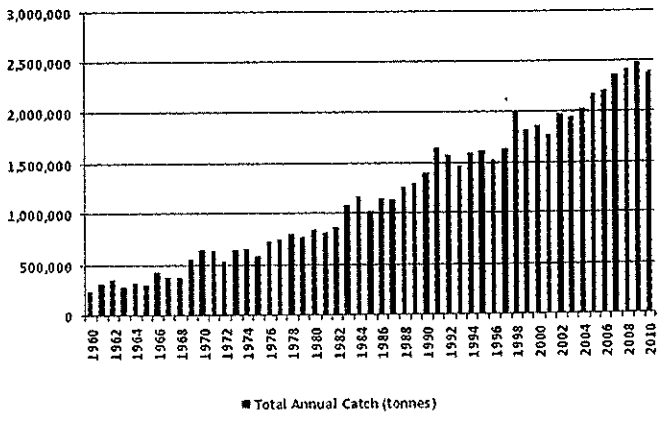

Figure 30.5. Regional Tuna Catch in the Western and Central Pacific Fisheries Convention Area (Source: SPC 2011).

Table 30.3

Tuna Catch by Gear Type in Western and Central Pacific Fisheries Region (Tonnes)

	Longline	Pole and line	Purse seine	Troll	Other	TOTAL
Year						
1970	141,360	409,754	16,222	50	69,633	637,019
1975	164,049	279,663	27,686	646	111,669	583,713
1980	227,707	395,746	113,266	1,489	102,645	840,853
1985	172,886	293,206	403,252	3,468	144,604	1,017,416
1990	181,591	250,390	773,730	7,219	196,934	1,409,864
1995	207,042	297,106	939,172	23,585	150,516	1,617,421
2000	217,465	261,937	1,191,103	25,845	184,693	1,881,043
2005	223,146	213,055	1,582,426	13,293	148,021	2,179,941
2010	248,589	171,597	1,818,255	9,988	172,684	2,414,692

Source: SPC 2011.

Table 30.4

Tuna Catch by Species in Western and Central Pacific Region (Tonnes)

	Albacore	Bigeye	Skipjack	Yellowfin	TOTAL
Year					
1970	74,350	40,102	423,348	99,216	637,016
1975	84,651	69,523	288,220	141,319	583,713
1980	95,156	72,948	455,747	217,002	840,853
1985	77,060	92,270	573,931	274,155	1,017,416
1990	63,872	131,723	850,180	364,089	1,409,864
1995	91,750	118,247	1,001,299	406,125	1,617,421
2000	101,161	156,097	1,142,508	481,277	1,881,043
2005	101,170	152,052	1,331,657	595,062	2,179,941
2010	126,017	125,757	1,610,578	558,761	2,421,113

Source: SPC 2011.

Skipjack and yellowfin catch by purse seine vessels are destined for canning either in the region or in canneries in Southeast Asia. Longline-caught bigeye and yellowfin are exported fresh or frozen to sashimi markets in Japan and the United States. Albacore has been used as "premium white meat" for canning, but it is increasingly being exported as fresh for sashimi.

Table 30.5 shows the catch by vessel flag. Historically, the majority of the purse seine catch has been by vessels from Japan, Korea, Chinese-Taipei, and the United States. In 1995, there were 145 purse seine vessels but these declined to 110 in 2007 (Williams and Terawasi 2008: 2). Conversely, there has been an increase in the number of vessels flagged by Pacific Island countries. In the overall Western and Central Pacific Convention Area, the fishing fleet consists of many smaller vessels in the Indonesian and Philippines domestic fisheries and a variety of other domestic and foreign vessels, including several relatively new distant-water entrants such as China, New Zealand, and Spain (Williams and Terawasi 2008: 3).

Skipjack tuna is a fast-growing species that has high resilience to fishing pressure and can support annual catches at the current level of 1.7 million tonnes. The current impact of the fishing represents a depletion of the adult biomass in equatorial waters of around 40 percent from unexploited levels. As this depletion is below the maximum sustainable yield, the stocks are considered to be in a healthy state (Hampton 2008).

Bigeye tuna is a slow-growing species that takes three to four years to mature. Significant exploitation of juveniles occurs in the purse seine fishery on floating fish aggregating devices and in the domestic fisheries of the Philippines and Indonesia (Hampton 2008). This has a subsequent impact on the adult population, which is the target of the longline fishery. Scientific assessment by the Secretariat of the Pacific Community (SPC) has indicated that there is overfishing of bigeye. Advice from the Western and Central Pacific Fisheries Commission (WCPFC) Scientific Committee is that fishing for bigeye tuna in the Western and Central Pacific must be reduced by 30 percent so that fishing can return to the average of 2003–2006 levels (Hampton 2008).

The yellowfin tuna is mostly harvested in the western equatorial region of the Western and Central Pacific by purse seine vessels

Table 30.5

Tuna Catch by Flagged Vessels in the Western and Central Pacific Ocean (Tonnes)

Country	1970	1980	1990	2000	2010
Australia	100	117	6,983	6,997	2,566
Belize	-	-	-	270	127
Canada	-	-	235	351	-
China	-	-	453	6,244	78,734
Cook Islands	-	-	-	335	3,058
Ecuador	-	-	-	3,992	8,451
El Salvador	-	-	-	-	6,824
Federated States of Micronesia	-	-	-	21,688	23,802
Fiji	-	2,496	3,830	9,660	10,060
French Polynesia	-	936	2,109	6,833	6,192
Indonesia	17,600	61,795	142,237	284,310	320,726
Japan	505,452	522,844	471,098	498,958	417,017
Kiribati	-	1,812	2,407	14,726	38,787
Republic of Korea	16,927	46,096	204,399	207,498	300,057
Marshall Islands	-	-	-	7,560	57,225
Nauru	-	-	-	11	4
New Caledonia	-	-	1,730	1,662	2,488
New Zealand	50	1,519	7,120	18,918	26,939
Niue	-	-	-	-	110
Palau	8,082	6,576	88	240	-
Papua New Guinea	2,428	33,994	-	68,818	208,253
Philippines	52,000	77,505	202,214	234,519	285,594
Russia	-	-	2,126	-	-
Samoa	-	-	-	5,389	3,090
Solomon Islands	-	23,241	26,612	12,929	24,785
Spain	-	-	-	12,896	29,485
Chinese Taipei	33,887	48,323	164,640	279,197	247,623
Tonga	-	-	192	1,161	128
Tokelau	-	-	-	-	4
Tuvalu	-	-	90	-	10,582
USA	493	13,483	171,301	135,410	256,872
Vanuatu	-	-	-	37,545	38,861
Vietnam	-	-	-	-	11,958
Eastern Pacific (NEI)	-	114	-	2,925	709
TOTAL	637,019	840,851	1,409,864	1,881,042	2,421,111

Source: SPC 2011.

and domestic fisheries of Philippines and Indonesia (Hampton 2008). Recent stock assessments indicate that stock is at least fully exploited and that there is a 50 percent chance that overfishing is occurring (Hampton 2008). In the case of albacore fishing, the Scientific Committee has advised that there should not be any further expansion of catch or effort, given that assessments show a depletion of adult biomass of around 60 percent (Hampton 2008).

Under the United Nations Fish Stocks Agreement (1995), cooperation between coastal states and distant-water fishing nations (DWFNs) is mandated to ensure the compatibility of conservation and management between EEZs and high seas because of the biological unity of the highly migratory fish stocks. In September 2000, the coastal states and DWFNs fishing in the Western and Central Pacific adopted the Convention on the Management and Conservation of Highly Migratory Fish Stocks in the Western and Central Pacific. The objective of the convention is to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stocks based on the

principles outlined in the Law of the Sea Convention (1982) and the United Nations Fish Stocks Agreement (1995).

The convention has led to the establishment of the Western and Central Pacific Fisheries Commission (WCPFC) in 2004. The commission has a permanent secretariat based in Pohnpei, FSM. It has two technical subcommittees, one dealing with compliance and the other with scientific issues. Conservation and management measures of the commission are legally binding and apply to all members in the convention area as shown in Figure 30.4. Some of the decisions of the commission include the need to reduce incidental catches of seabirds, reducing overcapacity, reducing the catch of nontarget species, and reducing the impact of fishing on sea turtles.

Nonliving Resources

Like fisheries resources, the nonliving resources can also be categorized as coastal and oceanic.

Coastal Nonliving Resources

In all Pacific Island countries, beach and lagoon sand and gravel are extracted for use as aggregates in construction activities. The demand for aggregate has been increasing alongside increase in population growth, urbanization, and housing development. The highly bulky granular materials have low unit value and are extracted close to the construction site. In Majuro, aggregate is obtained onshore, from beach mining, and near shore from dredging and reef blasting (McKenzie, Woodruff, and McClennen 2006: 9). In Majuro, 68 percent of the households surveyed collected aggregate from beaches for private use and the total annual household demand for aggregate was estimated to be approximately 10,587 m^3 per year (McKenzie, Woodruff, and McClennen 2006: 9). In Kiribati, the government, businesses, families, and donor-funded projects require aggregates to build homes, renovate buildings, construct seawall, and reclaim land (Greer Consulting 2007). The majority of the aggregates used to meet the demands are from beaches and coastal flats around Tarawa.

Dredging lagoons has been an important source of coral sand for the cement factory in Fiji. An assessment system under a tribunal exists in Fiji for compensating users toward the loss or diminution of fisheries resources when extraction takes place in the *qoliqoli,* or customary fishing rights areas.

There is continued use of hard boulders for lining septic tanks for private sewage systems in urban areas and for constructing seawalls and garden landscaping. This has raised environmental concerns in many island countries because of the potential harmful effects on reefs and marine organisms.

Oceanic Nonliving Resources

Polymetallic nodules containing nickel, copper, cobalt, and manganese have long been considered the prime economic mineral resource in the deep sea. These nodules have been known for more than a hundred years to exist on the deep ocean bed in the Pacific in depths of 4000 to 6000 m (Adams, Dalzell, and Ledua 1999: 378). Considerable effort and resources have been put into prospecting and developing methods of recovery. Since 1972, research interest in marine minerals within the South Pacific has been coordinated through the South Pacific Applied Geoscience Commission (SOPAC).

Demand for metals in countries like China and India and technological advances in the oil and gas industry have enabled extraction of hydrocarbons from depths of more than ten thousand feet and have led to renewed interest in mining manganese nodules. In the Pacific Ocean, research and exploratory studies have identified five areas that contain abundant nodules: the Carion-Clipperton Fracture Zone between Hawai'i and California, Central Southwestern Pacific Basin, Northeast-Pacific Musicians Seamount area, the Southern Ocean around 60° S latitude, and the Northern Peru Basin (Ghee and Valencia 1990; Kojima 2001). The central part of the Penryhn Basin between the Cook Islands and Kiribati west of the Southern Line Islands has been identified as having the highest potential (Tiffin 1988). In recent years mining companies have approached the Cook Islands government to conduct exploratory work within its EEZ. Rising fuel prices, uncertainty over ownership, and environmental problems relating to collection and processing of nodules could remain key obstacles to the mining of manganese nodules.

Polymetallic crusts or manganese crusts have a chemical composition similar to manganese nodules, but the cobalt content is three to five times higher than that of nodules (Kojima 2001). They are abundant on seamounts at depths of around 800 to 2400 m in the Western and Central Pacific such as in the waters of the Marshall Islands, the Federated States of Micronesia, and Kiribati (Ghee and Valencia 1990).

Minerals such as copper, gold, zinc, and silver could be extracted from massive seafloor sulfide deposits. Polymetallic sulfide deposits in the Pacific Islands have been found in the north of Fiji Basin, Lau Basin (Tonga), Eastern and Central Manus and Conical Seamount (Papua New Guinea) (International Seabed Authority 2006). Mining massive polymetallic sulfide deposits is likely to be viable when there are high gold and base-metal grades present, sites are located close to land, and water depths are less than 2,000 m. Most of the deposits located in the southwest Pacific therefore may be economical in the near future (SOPAC 2008). Nautilus Minerals Limited, which has exploration licenses for several sites in the southwest Pacific, is currently developing the technology to mine deep-sea polymetallic sulfide deposits (Magick 2008). Neptune Mining, which discovered two hydrothermally inactive seafloor sulfide zones on the Rumble II West seamount north of New Zealand in the Kermadec area, has been granted tenements in New Zealand, Papua New Guinea, the Federated States of Micronesia, and Vanuatu (*Fiji Times* 2008).

In November 2007, Nautilus Minerals was granted sixteen offshore exploration licenses covering about 88,000 km^2 in which there are also occurrences of polymetallic sulfide (SOPAC 2008), to begin deep-sea mining of polymetallic sulfide deposits in the Manus Basin, located in Papua New Guinea's territorial sea. Korea has also secured rights to develop mineral resources in a 20,000 km^2 area within Tonga's EEZ in which mineral deposits are estimated around nine million tons and which include minerals such as gold, copper, silver, and zinc (Pacnews 2008a, 2008b).

Although exploration studies on hydrocarbons by SOPAC so far have revealed the presence of more deep sedimentary basins

in island arc countries such as Solomon Islands and Vanuatu, no petroleum accumulations have yet been discovered (SOPAC 2008). The Bligh Water Basin and Bau Waters Basin in Fiji have geological features similar to those of Southeast Asia, where major reserves of oil and gas have been discovered (SOPAC 2008). While drilling activities between 1969 and 1987 revealed the presence of rock capable of generating oil and gas, no commercial reserves were discovered (SOPAC 2008). The main factors that determine the economics of an oil field are the price of oil, the size of the oil field, well productivity, well depth, and water depth (Rodd and van Meurs 1993).

Nonextractive Uses

Tourism in the Pacific is one of the fastest-growing industries, and most countries see their white sandy beaches, coral reefs, and lagoon-based resources as the prime attraction. A study by South Pacific Travel (formerly the South Pacific Tourism Organisation) in 2005 estimated that a total of US$1.75 billion was spent by tourists across its thirteen Pacific Island member countries (Pacific Islands Forum 2008). Tourism is a major contributor to GDP in the Cook Islands and is the main source of foreign exchange in Fiji. It is also of economic importance to Hawai'i, Guam, and the Northern Mariana Islands. Most hotels and resorts are strategically located along the coastal areas to take advantage of coastal and ocean-based activities such as snorkeling, diving, surfing, kayaking, and whale watching.

The Pacific Islands region has a high diversity of cetaceans (whales, dolphins, and porpoises). It contains important breeding, calving, and feeding grounds and provides the migratory pathways for many species. In 2005, tourists and Pacific Islanders made more than 110,700 visits to watch whales and dolphins and spent an estimated US$21,011,873 (IFAW 2008). Countries with the strongest growth in whale watching are Guam and French Polynesia, whereas New Caledonia and Tonga have continued sustained growth (IFAW 2008). Whale watching is also a big business in New Zealand, where the total expenditure in 2004 was estimated to be NZ$72,338,157 (IFAW 2005).

Tourists are also attracted to the deep blue seas of the Pacific region to dive among the sea turtles, dolphins, sharks, rays, and whales among the World War II wrecks and reef areas.

Surfing is another major water sport that not only draws tourists but also attracts competitive sporting events. For example, famous Hawaiian wave swells, generated from October to March from deep lows tracking across the North Pacific, can be anywhere from ten to thirty feet. Surfing spots are also found in New Zealand, the Cook Islands, American Samoa, Fiji, French Polynesia, and New Caledonia.

Certain spots along Fiji's wide reef expanse are protected sites, such as the "Shark Reef," a hard coral reef off the coast of the largest island Viti Levu, which is a habitat of many culturally significant shark populations. Shark feeding has been a major tourist attraction in the area for the past seven years (waidroka.com).

Besides receiving direct benefits such as food, people derive other benefits from marine ecosystems, such as protection from natural hazards, carbon capture, potential pharmaceutical ingredients and genetic materials, nursery grounds, and so on. Human well-being depends on these "ecosystem services," so maintaining the ecological integrity of the ecosystems is critical for human well-being. Establishing and maintaining marine protected areas are the most plausible way to preserve the pristine ecosystems and the best way to provide protection for endangered species.

In order to preserve the unique, rare, and pristine environment, the Kiribati government, together with the New England Aquarium and Conservation International, established the Phoenix Islands Protected Area, which at 410,500 km² is currently the largest marine protected area (MPA) in the world today. This MPA contains deep-sea habitats, eight atolls, and two submerged reef systems (phoenixislands.org). More than 120 species of coral and 514 species of reef fish have been identified so far, and the area also includes a sanctuary for seabird aggregation (phoenixislands.org). The MPA is financed through an endowment fund that will assist in compensating the people of Kiribati for the loss of fishing license revenue and pay surveillance and management costs.

In addition to the Phoenix Island Marine Protected Area, leaders of Palau, FSM, the Marshall Islands, Guam, and the Northern Marianas made a commitment at the Conference of Parties under the United Nations Convention on Biological Diversity in March 2006 to conserve 30 percent of their nearshore marine and 20 percent of their terrestrial resources across Micronesia. This initiative is known as the "Micronesia Challenge" and covers an area of 6.7 million km², representing 5 percent of the Pacific Ocean. The leaders hope that this can assist in protecting 66 currently identified threatened species, 10 percent of the global total reef area, and 462 coral species (*Pacific Magazine* 2008).

Other Uses

While aspects of mariculture and aquaculture have been briefly discussed under coastal fisheries, they can easily be considered as another use of ocean resources because of their growing importance in the global food supply. Aquaculture continues to grow more rapidly than all other animal food-producing sectors (FAO 2007: 16). In the Pacific Islands that are surrounded by sheltered bays and lagoons, aquaculture is seen as having the potential to cultivate new commodities, as a means of stock enhancement, and way to rehabilitate reefs and lagoons. Table 30.6 gives a summary of the various species that are currently being cultivated in the Pacific Island region.

Most of the production in the smaller island countries is relatively small-scale or still at an experimental stage. Notable commercial cultivation is that of pearls, seaweeds, tilapia, giant clams, shrimps, and freshwater prawns. About sixty tonnes of freshwater prawns were produced in Fiji in 2006 (Fiji Fisheries Department 2008). These were targeted at the growing hotel and tourism industry and mostly sold domestically. Kiribati has had a regular production of *Eucheuma* since 1986, although annual production is declining after reaching a peak of 11,174 tons in 2000 (FAO 2005). Access to markets has been a major factor for the *Eucheuma* and is probably the reason the industry has not had a full takeoff even though there are several suitable sites for cultivation. While the potential for aquaculture exists, there are several environmental and institutional factors that need to be considered. The availability of seed and feed; marine tenure systems; biological risk factors such

Table 30.6

Cultivation of Aquaculture Commodities in the Pacific Islands Region

Commodity	Countries cultivating
Barramundi	French Polynesia, Papua New Guinea
Carp	Fiji, Papua New Guinea
Clams (*Anadara*, bear paw, nei)	Fiji, Palau, Samoa, Tonga, Micronesia
Crocodile	Papua New Guinea
Freshwater prawns	Fiji, French Polynesia
Giant clam (crocus, elongate, fluted, smooth, nei)	Palau, Samoa, Tonga, Cook Islands, Solomon Islands, Marshall Islands, Fiji, Micronesia, French Polynesia
Hard coral/ Live rock	Fiji, Tonga, Vanuatu, Marshall Islands, Micronesia
Marine fish nei	French Polynesia
Marine shrimps (blue, banana, tiger, whiteleg)	French Polynesia, New Caledonia, Vanuatu, Fiji, Cook Islands, Solomon islands, Papua New Guinea, Guam, Northern Marianas
Milkfish	Guam, Kiribati. Micronesia, Palau, Tuvalu, Cook Islands, French Polynesia, Nauru
Mullet (flathead, grey, nei)	Fiji, Guam
Mussel (green, Sea nei)	New Zealand, French Polynesia, Fiji
Oysters (mangrove cupped, Pacific, nei)	New Zealand, Papua New Guinea, New Caledonia
Pearl Oysters (blacklip, nei)	French Polynesia, Cook Islands, Fiji, Papua New Guinea, Marshall Islands, Micronesia
Seaweed (elkhorn, seamoss, Eucheuma, Zanzibar weed)	Tonga, Fiji, Solomon Islands, Kiribati, Micronesia
Southern crayfish	New Caledonia
Spinefoot (rabbitfish)	Fiji
Sponge	Micronesia
Tilapia	Fiji, Papua New Guinea, Vanuatu, Samoa, American Samoa, Guam, French Polynesia
Trout and salmon	New Zealand, Papua New Guinea

Source: Adapted from FAO 2005; Hamberg Consulting in association with Nautilus Consultants 2011.

as diseases and competition; and natural disasters in the fragile island coastal ecosystems are just some of the considerations.

In the broader sense of how the ocean impacts Pacific Islanders, it is also important to consider their dependence on ocean-based trade and the seafaring lifestyle that supports their social and economic needs. Shipping facilitates exports and contributes to economic growth and trade opportunities. Many of the countries are highly dependent on imports of food, fuel, and manufactured items. Bulky export commodities such timber, copper ores and concentrates, palm oil, sugar, and so on are transported by ocean-based tankers and container ships.

Many Pacific Islanders also work on foreign vessels as seafarers and send money back to their families. In Tuvalu, for example, remittances are approximately 30 percent of the gross national product (Clark 2003). Papua New Guinea, Solomon Islands, Fiji, Samoa, Tonga, and the Marshall Islands also have a number of seafarers on foreign vessels, and remittances are also important means of alternative livelihood.

Threats to Ocean Resources

While seafood remains an important source of protein for the Pacific Islands, catches of most accessible stocks have been declining over the years. In islands where data is collected routinely, the recorded decline has been dramatic; in Guam, for example, catch rates have declined by 70 percent over the past fifteen years (King et al. 2003: 1). In a survey carried out by the Secretariat of the Pacific Community, the declines in fisheries catches have been attributed to overexploitation, shift from subsistence to commercial operations, use of overly efficient and destructive fishing methods, and environmental degradation (King et al. 2003: 1). Chemical and traditional poisons, fish drives, use of scuba gear and underwater torches, small mesh sizes of nets, and uncontrolled fishing have led to the degradation of marine ecosystems. A number of reports have raised concerns about the sustainability of coastal fisheries resources (see, for example, Thistlethwait and Votaw 1992; Dalzell and Schug 2002). Targeting large predatory species for the live reef

fish market has generated particular concern due to the ease with which most fish can be caught. Groupers are particularly vulnerable, as they aggregate to spawn in reef areas. Johannes et al. (1999) noted that grouper spawning aggregations have been fished to near extinction in many places in the Pacific Islands such as Palau, the Cook Islands, and French Polynesia.

For a number of Pacific islands, even the most distant or highest point of land is close to the sea, and activity on land often has significant effects on the marine resources. Urbanization leads to destruction of mangroves and beaches. Pollution from industries, settlements, harbors, and ports contributes to fouling of the nearshore and reef areas that reduces the productivity of areas that support fishing activities, as well as posing risks for human health. Improper disposal of sewage and domestic solid waste have been one of the major environmental problems of urbanization. Increased flow of nutrients often leads to eutrophication and eventual fish kills. Sedimentation due to deforestation, mining, and changes to land use also contribute to loss of coral cover.

Use of large and technologically efficient fishing vessels with limited controls on fishing have also led to overexploitation of important tuna resources. Figures 30.6 and 30.7 provide an illustration of the relative technologies used in inshore and oceanic fisheries. Figure 30.6 shows tuna vessels in port, while Figure 30.7 shows typical small-scale artisanal vessels. Many countries initially issued licenses to foreign fishing vessels in order to raise revenue, but they did not use adequate and sound scientific data on which to base their fishing limits. This problem has been further exacerbated by increased fishing pressure by distant-water fishing vessels fishing in the high seas and high seas pockets over the years. Even if Pacific Island countries were to manage the tuna fisheries effectively in their regulated zones, management would be undermined by this uncontrolled fishing on the high seas, since tunas are highly migratory and move between EEZs and high seas.

With limited sources of revenues, many governments in the Pacific Islands have given priority to their short-term economic needs by issuing more licenses than recommended by scientific advisors. This has led to the overexploitation of important tuna resources such as the bigeye and yellowfin tuna.

The vast distances between islands also makes monitoring and surveillance work both logistically difficult and expensive. Consequently, the Western and Central Pacific region, which has the world's largest tuna resources, attracts illegal fishers and vessel operators from around the world. Commonly known as illegal, unreported, and unregulated (IUU) fishing, it has become a major concern for the Pacific Islands region that could undermine the sustainability of the important tuna resources. A recent Greenpeace study shows that European-owned and/or operated purse seine vessels with Ecuadorian, Venezuelan, and Netherland Antilles flags licensed to fish in the Eastern Pacific were involved in IUU fishing in the Western and Central Pacific (Greenpeace 2007). The report further states that eleven Latin American– and Netherland Antilles–flagged vessels have been observed and some arrested for illegally fishing in the EEZ of Jarvis, Howard and Baker, Kiribati, the Cook Islands, and French Polynesia (Greenpeace 2007). Illegal fishing costs millions of dollars in lost revenues—in Papua New Guinea alone, an estimated US$18 million was lost as a result of purse seine and longline vessels underreporting and illegally fishing in their EEZ.

Figure 30.6. Tuna vessels in port (photo JS).

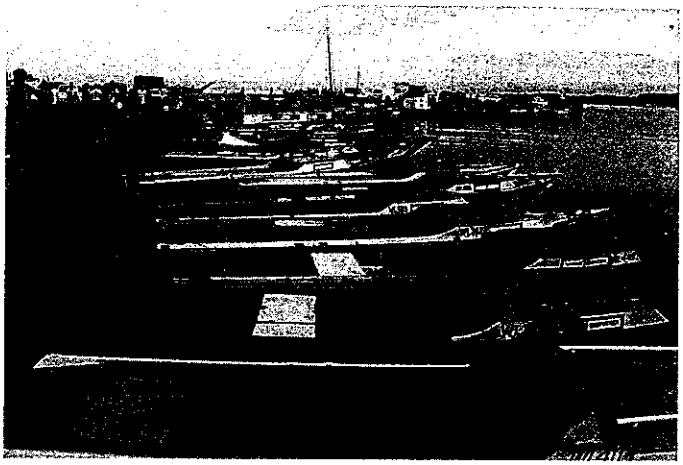

Figure 30.7. Artisanal vessels in port (photo VRB).

"Fishing down the food web" can lead to diverse impacts on the biodiversity of the oceans. Loss of biodiversity can have a disastrous effect on the supply of seafood. There are also concerns about the nonselective nature of tuna fisheries that increases the mortality of sharks, turtles, and other billfishes.

Beach mining has been a problem particularly in the low coralline islands or atolls which have critical shortages of suitable construction grade sand and aggregate for infrastructure development. This not only destroys the habitats of marine organisms but also increases the islands' vulnerability to storm surges and coastal flooding.

Sustainability and Management Issues

The very existence of many Pacific Island communities depends on the continued health of their marine environment and its resources. Intensive fishing associated with population increase and the use of efficient fishing technologies pose major threats to the sustainability of both coastal and oceanic fisheries resources. Command-and-control fisheries governance based on legislative control such as catch limits, seasonal closures, and size limits are effective only where there is a strong monitoring and enforcement capability.

Considering the nature of coastal-based subsistence and artisanal fishing operations and with limited government enforcement capabilities, community-based resource management systems that incorporate stakeholder participation are seen to be more effective. In the Pacific Islands, a number of case studies show that participatory fisheries governance is most successful where social and cultural ties remain strong (see, for example, Kuemlangan 2004). This is recognized as an effective approach in the recently developed strategic plan for regional coastal fisheries, which states that "community empowerment [is] to be responsible for sustainable fisheries management within the boundaries of its traditional fishing grounds" (SPC 2008b: 2). By empowering community self-management of fisheries regulations, customary marine tenure has the potential to provide a cost-effective means to enforce fisheries management measures. Helping to enhance the stewardship of the resources partially or fully resolves the problem of open access, which is often blamed for excess fishing capacity. Figure 30.8 shows rehabilitation of a mangrove area under a community project in Fiji.

Figure 30.8. Mangrove replanting for rehabilitation (photo VRB).

In order to manage the coastal resources, therefore, there is a need to strengthen and revive the traditional marine tenure and resource allocation mechanisms. This is most effectively done through partnerships and collaborative efforts between countries, governments, scientists, and other stakeholders. Through the use of scientific information and traditional knowledge, effective resource-management measures and best practices could be identified and adopted by the local communities. The locally managed marine areas (LMMA) approach in Fiji is an example of such a collaborative approach, where scientific studies are used to determine the *tabu*, or protected areas.

Ideally the protected zones, or *tabu*, within a particular area should enable the preservation of habitats that play a key role in early life stages of coastal and marine species. Conservation strategies should provide protected areas the needed support so that they can maintain the replenishment of populations in the wider marine and coastal environment (United Nations 2000).

The main management issue facing the oceanic fisheries is the current overexploitation of bigeye and possibly yellowfin tuna due to increased fishing capacity in the Western and Central Pacific region. Scientific advice suggests that there should be a reduction in fishing of bigeye tuna, a reduction in purse seine fishing that uses floating objects and FADs that increase fishing mortality of juvenile yellowfin, and a reduction in fishing activities in Indonesia and Philippines waters, which provide the breeding ground for tuna that eventually migrate southward (Hampton 2008).

While management measures have been agreed upon by the Western and Central Pacific Fisheries Commission members, limited action has been taken so far because some members are still interested in fulfilling their short-term economic interests.

A number of Pacific Islands countries face the dilemma of choosing between their social and economic development aspirations and revenue from expanded fishing. The highly migratory tuna requires an effective enforcement mechanism to ensure that illegal fishing is eliminated. There is a need for a more genuine and committed approach to regional and international cooperation among the coastal states themselves and with the distant-water fishing nations. Innovative cooperative approaches will need to be identified sooner rather than later to ensure the long-term sustainability of the tuna stocks. There are several commission decisions and resolutions that require implementation at the national level, such as the regional vessel monitoring and data-reporting requirements aimed at improving the basis for management decisions.

While deriving economic benefits from the seabed seems a near reality, seabed mining raises the fundamental problem of boundary delimitation. Countries with overlapping boundaries must enter into negotiations with neighboring countries for an agreement on shared boundaries before declaring their maritime boundaries. There are a number of shared boundaries in the Pacific Islands region that are yet to be negotiated.

Realizing the ocean's potential as well as dealing with the accompanying threats requires a further strengthening of the institutional approaches to the management of marine and coastal resources through better coordination among countries and national government sectors and departments. A cooperative network of departmental, local, national, and regional management together with active participation of civil society is necessary. The need for cooperative and coordinated approaches between the Pacific Islands countries and the Pacific Rim countries is a critical factor because of the transboundary nature of the ocean resources, whether it is harvesting fisheries resources or conducting seabed mining.

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