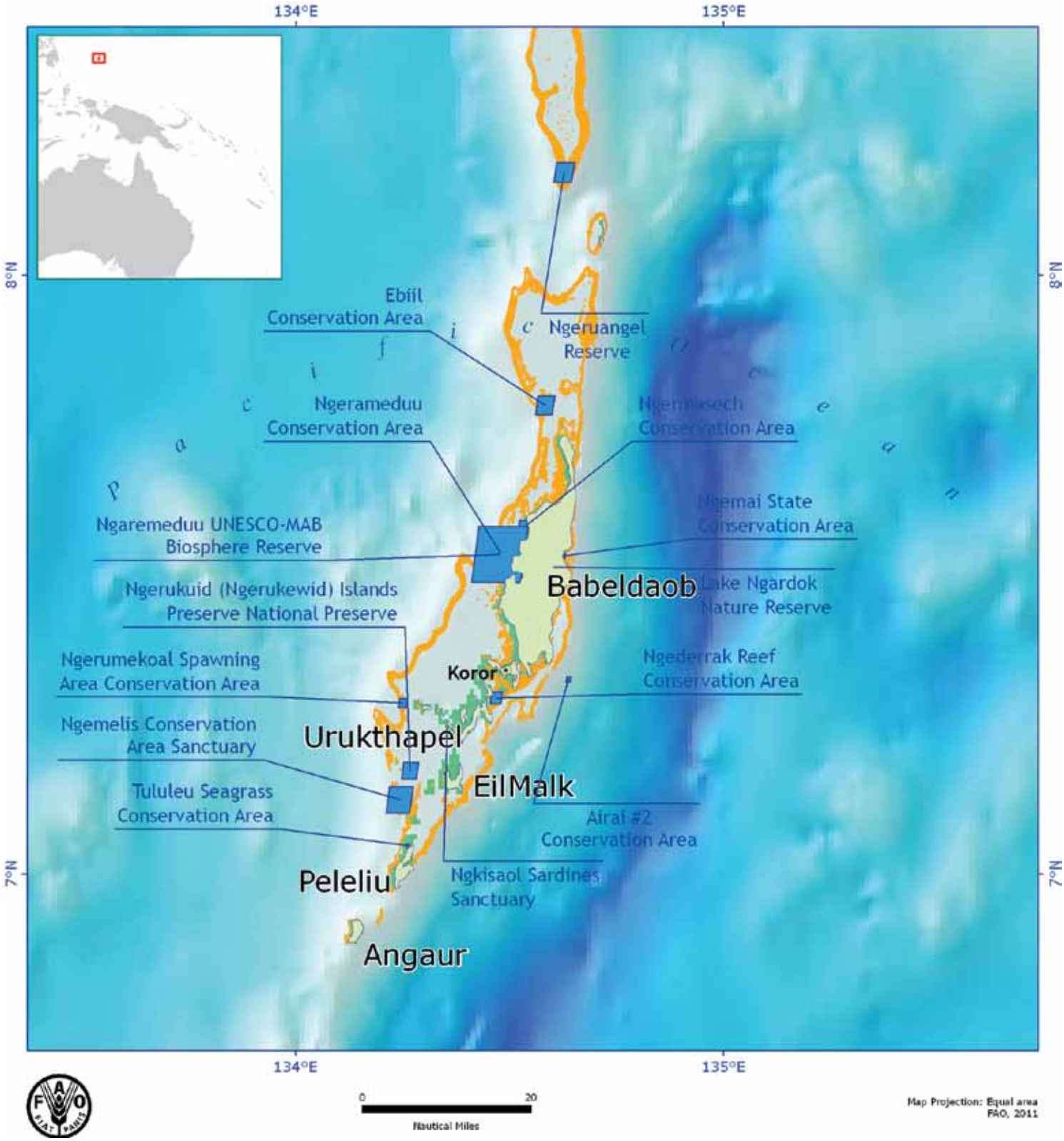
Map 1
Map of Palau and marine protected areas



Palau

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1. INTRODUCTION

The Republic of Palau lies at the western end of Micronesia (Map 1), 800 kilometres (km) east of the Philippines and 800 km north of Papua New Guinea. By virtue of its position near the Philippines, the recognized centre of biodiversity (Carpenter and Springer, 2005), Palau has a more-varied species list than other islands in the Oceania group.

The 586 islands of the Palau archipelago stretch over 700 km in a north-south direction, although only 12 of the islands are continuously inhabited. Located at the point where the Pacific tectonic plate is subducting under the Philippine plate, Palau has both extensive areas of shallow reef and some of the deepest waters on earth.

Palau has been inhabited for over 4 000 years, and the shallow-water coastal reefs (see Figure 1) have a long history of exploitation (Fitzpatrick and Donaldson, 2007). In the last decade or so, communities in Palau have noted a decline in the abundance and size of target species as a result of overexploitation and development (Davis and Kearns, 2003). Despite the extended list of pressures acting on the coastal system, the marine environment of Palau remains relatively intact, with only moderate population pressure (46 people/km^2). Communities still have a traditional focus on environmental conservation and this provides various options for protection through spatial management (Kelty *et al.,* 2004).

FIGURE 1
Ngederrak reef

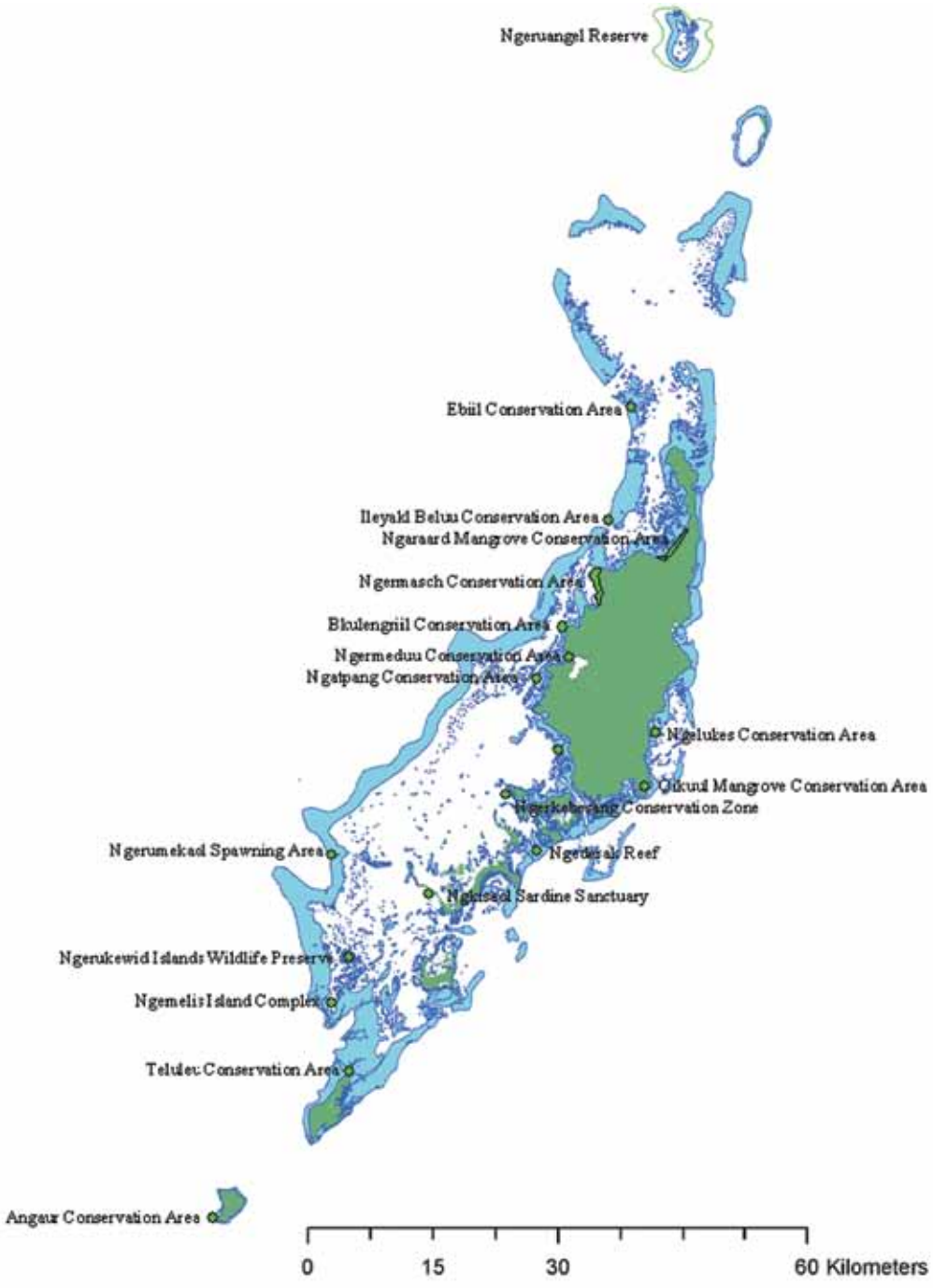
PHOTO: YIMNANG GOLBUU

2. FISHERIES AND SPATIAL MANAGEMENT

2.1 General condition of marine fisheries

The Palauan archipelago is predominantly volcanic in origin, with a total land area of 444 km^2 (Figure 2). It incorporates 1 034 km^2 of shallow tropical lagoon and an exclusive economic zone of 629 000 km^2 (SPC, 2008a; Fitzpatrick and Donaldson, 2007). With a small, but ageing population of 20 279 people (SPC, 2008a), Palau has one

FIGURE 2
Map of Babeldaob with smaller islands to the north and south



Note: The position of marine protected areas is noted, although Sonsorol and Hatobohei States in the south are not represented.

Palau's biological significance

- high number of diverse marine environments (habitats) present;
- highest diversity of reef fish in Micronesia, with >1 278 species (Myers, 1999);
- more than 350 species of hard and 200 species of soft corals (northeast margin of the 'coral triangle');
- estimated >500 sponge species (Kelly-Borges and Valentine, 1995);
- extensive list of opisthobranchs, with >185 species;
- twenty-one species of crinoid fauna (Meyer and Macurda, 1980);
- home to seven of the nine species of giant clams;
- an endemic nautilus, *Nautilus belauensis*;
- home to the most isolated *Dugong dugon* population in the world;
- the only hawskbill turtle, *Eretmochelys imbricata,* breeding site in Micronesia;
- the largest number of resident bird species in Micronesia.

of the region's lowest unemployment rates (2.3 percent in 2000) and a large presence of foreign workers (Asian Development Bank, 2005).

Three ocean currents converge in Palau's waters, bringing diversity to coastal marine habitats dominated by coral reefs (outer reef 265 km^2, inner reef 187 km^2 and mangrove 45 km^2). Lying outside the typhoon belt, Palau has a high density of relatively intact tropical marine habitats and related communities (see box). In addition to coral reefs, mangroves and seagrass beds, there are deep algal beds, mud basins, current-swept lagoon bottoms, rich tidal channels and anoxic basins (Turgeon *et al.,* 2002; Kelty *et al.,* 2004; Fitzpatrick and Donaldson, 2007).

The fisheries contribution to gross domestic product (GDP) remained stable at ~2.2 percent from 2002 to 2006 (Palau Office of Planning and Statistics). Although Gillett and Lightfoot (2001) highlighted a decline in the fisheries contribution (from ~8 percent in the late 1990s), it was mostly due to variations in the number of locally based oceanic fishery vessels and strong growth in the tourism sector.

As is the case with other island countries in the region, inshore fishing is critical to Palau's domestic food supply. The reef fishery is a multispecies, multigear fishery with a range of species targeted (Nichols, 1991; Hinchley *et al.,* 2007). Approximately 80 species of reef fish from 13 families are typically taken, although rabbitfishes (Siganidae) comprise the dominant composition of landings. Parrotfishes (Scaridae) are also an important part of the artisanal sector, with groupers (Serranidae) and humphead wrasse (*Cheilinus undulatus*) important in both subsistence and semi-commercial fisheries. Heavy exploitation of groupers and humphead wrasse in the 1980s and 1990s for the live reef food fishery affected these populations (Graham, 1996, 2001; Kitalong and Oiterong, 1992; Davis and Kearns, 2003). Efforts to control the fishery were slow in coming, although a national ban on the live reef food fishery was instituted in 2008.

The deep-water fish resource is also important; catches are dominated by 13 species of the families Lutjanidae, Lethrinidae and Serranidae (Nichols, 1991). Invertebrates of commercial importance include the native topshell trochus, *Trochus niloticus* (Maragos *et al.,* 1994; Matthews, 2003). Giant clams are a traditional food and are regularly taken for subsistence purposes, although surplus is offered for sale at local markets and exportation of the meat or whole shell collected from the wild is controlled. Pearl oyster (*Pinctada margaritifera*) fishing was important during the Japanese administration, but wild stock collection ceased as stock became depleted (Maragos *et al.,* 1994). Three species of spiny rock lobster (family Palinuridae) are important in subsistence and commercial fisheries, while mudcrab (or mangrove crab, *Scylla serrata)* is an important catch in the semi-commercial sector. Some 22 commercial species of sea

cucumber offer potential for export (Friedman *et al.,* 2010) and past records show that at least eight have been exported (Fitzpatrick and Donaldson, 2007). While exportation of six commercial sea cucumber species is currently prohibited, at least four species are eaten locally (Friedman *et al.,* 2010; Kitalong, 2008). Lastly, there is a long history of marine aquarium trade (from the mid-1980s), with the participation of the Palau Mariculture Demonstration Center, and one private company, Belau Aquaculture, operating in Palau (Graham, 1996).

It is important to note that tourism is still the single most important industry, with an increase of 63 percent in the past six years, from 54 000 visitors in 2001 to 88 175 visitors in 2007 (Palau Visitors Authority data, 2008). A main attraction for visitors is the spectacular diversity of the marine environment, including the protected 'rock islands' and marine 'jellyfish lake'.

The immediate threats to Palau's biodiversity stem from inappropriate use of natural resources owing to fisheries development, tourism activities (Davis and Kearns, 2003), population growth and economic development (Hinchley *et al.,* 2007). Additionally, the construction of a 52-mile road around the largest island, Babeldaob, threatens coastal environments through greater access, the wider ramifications of beach and foreshore development, run-off, siltation, waste disposal and habitat loss (Golbuu *et al.,* 2003; Victor *et al.,* 2004). Longer-term, climate-induced changes also threaten biodiversity, with coral bleaching having repeated impact: high levels of coral bleaching and mortality followed an El Niño Southern Oscillation (ENSO) event in 1998. These ENSO-driven events are expected to increase in frequency and intensity in coming years.

2.2 Spatial management in fisheries and conservation

The challenge of inshore fisheries management in Palau centres on balancing exploitation of resources for subsistence and commercial activities with the maintenance of a healthy ecosystem with high biodiversity. Subsistence and small-scale commercial fishing ranges from simple hand collection to hook-and-line fishing, underwater spear-fishing, net fishing and trolling. Fishing typically involves small fishing craft, generally 4.8–7.6 m in length and powered by an outboard motor. At least 25 percent of households own fishing boats, and through the extended family system most fishers have access to boats.

Traditionally, Palau has had strong community control (tenure in Palau is determined through matrilineal descent) that allows areas to be closed to fishing through implementation of traditional moratoriums, or *bul*, prohibiting all use for a restricted period, but usually not indefinitely. The majority of community marine protected areas (MPAs) have been designated to address local concerns regarding decreased commercial fish populations, and to manage the needs of tourism effectively. Although the Palau community system of management is strong, intermarriage among communities and a more westernized approach to life are slowly making more and more areas 'open access' for fishing (Mersai, 2007). This is particularly true for commercial fisheries, which operate outside rapidly eroding traditional controls.

Palau's main fisheries law regulates both foreign and domestic fishing through the Palau National Code, Title 27. Other relevant legislation relates to environmental protection through the Palau National Code, Title 24. These domestic controls for coastal fisheries concentrate primarily on controlling the exploitation of groupers, wrasses, parrotfishes, turtles, giant clams, pearl oysters, sea cucumbers, crabs and dugongs.[1] Further legislation in Chapter 13 of the code specifies "illegal methods of capture", and seeks to protect stocks and habitats through the banning of destructive fishing practices.

[1] Palau National Code, Title 24, Division 2, Chapter 12: Protected Sea Life, and the 1994 Marine Protection Act.

Recognizing the difficulty of enforcing national input and catch controls, Palau's communities, non-governmental organizations (NGOs) and government have instituted numerous MPAs, emerging as leaders of spatial management for conservation in the Pacific. This includes protection of grouper spawning aggregation sites, the Ngerukeuid Islands Preserve, and multiuse protection of other rock islands and surrounding waters, including key tourist sites such as the marine jellyfish lake.

2.3 Institutions

Traditional community management (the Council of Chiefs and Council of Women) and civil society are engaged in conservation in Palau (Ridep-Morris, 2004; Table 1). Communities and civil groups advocate marine resource management through spatial controls. However, the influence of the traditional system is declining (Mersai, 2007), with traditional chiefs being integrated into more-centralized state and national government roles.

NGOs play an important role in advocating protection of the marine environment. They conduct a range of activities, starting with community consultation and development of local structures for community-based management, with ongoing research and monitoring (Table 1). The Palau Conservation Society (PCS), the Palau International Coral Reef Centre (PICRC), the Coral Reef Research Foundation (CRRF) and The Nature Conservancy (TNC) are the most prominent groups supporting conservation through spatial management in Palau.

Government control is distributed in national and state institutions. Article IX, Section 5.12 of Palau's Constitution states that marine resource conservation in the national interest falls within the purview of the national government, whereas Article I, Section 2 confers on the country's 16 states the ownership of all marine resources found within 12 nautical miles of state boundaries. This charges national and state government agencies with marine resource management, giving both a legislative role in marine conservation (Table 1).

TABLE 1
Institutions and their responsibility for coastal environment and fishery resource management in Palau

Agency	Planning/ management	Research	Monitoring	Education/ outreach	Training	Surveillance/ enforcement
Civil Society: Council of Chiefs and Council of Women	X		Various projects			
Palau Community College		X		X		
Coral Reef Research Foundation crrf@palaunet.com		X	Temperature, marine lakes			
The Nature Conservancy micronesia@tnc.org	X	X			X	
Palau Conservation Society PCS@palaunet.com			MPAs	X		
Palau International Coral Reef Center www.picrc.org		X	MPAs, fish, corals, watersheds	X	X	
Koror State Department of Conservation and Law Enforcement	X	X	Marine lakes, rock islands	X	X	X
Palau Mariculture Demonstration Center		X	Restocked fauna	X	X	
Palau Fishing Authority	X					
Environmental Quality Protection Board	X		Water quality	X		X
Bureau of Marine Resources and Ministry of Natural Resources, Environment and Tourism	X	X	Stock status, fish markets and exports	X	X	X
Division of Fish and Wildlife				X		X

The national Palau Maritime Authority (mandated under the Palau National Code, Title 27) licenses fishing activity within the offshore fisheries zone (from 24 to 200 miles). Within coastal waters (territorial waters: shoreline to 12 miles and the contiguous zone out to 24 miles) a number of agencies are active, including the state government of each of the 16 states of Palau. The Ministry of Natural Resources, Environment and Tourism (formed January 2009), which includes the Bureau of Marine Resources (BMR), is supported by the Fisheries Act of 1975 and its regulations under the Palau National Code (see Sisior, 2007). Its mandate includes marine research and development, resource management, technology transfer, technical advisory and extension services, statistical monitoring and recommendations for legislation. In addition, the BMR is responsible for promoting the commercialization of certain mariculture species carried out by the Palau Mariculture Demonstration Center. Other agencies, also in charge of conservation and monitoring, such as the Division of Fish and Wildlife (previously the Division of Conservation and Entomology), are shown in Table 1.

Through intergovernmental agencies – such as the Secretariat of the Pacific Community (SPC), the Forum Fisheries Agency and the South Pacific Regional Environmental Programme – Palau also participates in greater regional programmes that deal with fisheries and environmental issues.

3. MPAs FOR FISHERIES AND CONSERVATION: DESIGN AND MANAGEMENT STATUS

Most MPAs in Palau are established to provide protection for marine resources, or occasionally to protect tourist sites, rather than to conserve a proportion of representative habitats or environments. The designation of MPAs has generally been instigated by communities, with the assistance of NGOs, and enacted by both national and state government bodies.

3.1 MPA terminology

Results of initial rapid ecological assessments in the early 1990s led to 50 prospective sites for conservation being proposed by state leaders. The sites were selected on the basis of their outstanding ecological or biological value. Maragos and Cook (1995) suggested seven types of management areas for the marine environment in Palau, including national park, ecological reserve, marine preserve, coastal conservation area, fishery conservation area, tourism site and special management area. Through discussion, leaders of the 16 states of Palau classified the 50 sites into 28 fishery conservation areas, 7 marine reserves, 4 forest preserves, 4 ecological reserves and 2 coastal conservation areas, with the remaining 5 including a national park (e.g. rock islands) and special management areas.

This characterization of MPAs was further adapted by the Government of Palau into four national heritage categories (national heritage area, national heritage preserve, national heritage reserve and special management area), which took advantage of the content of the 1991 National Heritage Reserve Systems Act.[2] This framework for designating MPAs went through a final iteration in 2003, when the National Heritage Reserve Systems Act was repealed and replaced by the Protected Areas Network (PAN) Act (Table 2).

The PAN Act applies two types of categories in characterizing protected areas in Palau: management categories and use categories (Table 2). The first type follows the guidelines for protected area management of the International Union for Conservation of Nature (IUCN) and consists of six levels of protection (IUCN, 1994). The second reflects traditional local and/or national uses of protected areas: (A) restricted non-

[2] Palau National Code, Title 24, Division III, Chapter 32.

TABLE 2
Palau marine management matrix, under the Protected Areas Network (PAN) Act

	A Restricted non-extractive uses	B Non-extractive uses	C Sustainable uses	D Others
IUCN Ia	Ia-A	n.a.	n.a.	Ia-D
IUCN Ib	Ib-A	Ib-B	n.a.	Ib-D
IUCN II	II-A	II-B	II-C	II-D
IUCN III	III-A	III-B	III-C	III-D
IUCN IV	IV-A	IV-B	IV-C	IV-D
IUCN V	V-A	V-B	V-C	V-D
IUCN VI	VI-A	VI-B	VI-C	VI-D

Note: IUCN categories (1994): (Ia) strict nature reserve, protected for science; (Ib) wilderness area, preserve in an unmodified condition; (II) ecosystem protection and recreation; (III) conservation of specific natural features; (IV) habitat-species management area; (V) landscape and seascape, conservation and recreation; and (VI) sustainable-use area.

extractive uses (permission or permit required; recreation or extractive use not allowed; education, monitoring or research with permission); (B) non-extractive uses (permission or permit may be required; education, monitoring and/or research use allowed; extractive uses not allowed); (C) sustainable uses (permission or permit may be required; education, monitoring and/or research use allowed; sustainable and/or subsistence extractive uses may be allowed); and (D) 'other' uses.

Categorizations for protected areas available through intergovernmental agencies and the World Conservation Monitoring Centre do not list the current situation of marine spatial management in Palau effectively. However, a number of researchers have documented from 28 to 30 reserve areas of various types, ranging from traditional closures to protected state and national conservation areas (Verheij and Aitaro, 2007 and Table 3; Verheij and Austin, 2008; Hinchley *et al.*, 2007).

TABLE 3
MPA with related institution and definitions

Name	State	Size (km^2)	Use	Comments
Imul Mangrove Conservation Area	Aimeliik	0.4	A	Protection of mangroves
Ngchesechang Mangrove Conservation Area	Airai	1.0	C	Protection of mangroves
Ngeream Conservation Area	Airai	1.6	C	Protection of mangroves
Oikul Mangrove Conservation Area	Airai	0.8	C	Protection of mangroves
Helen Reef	Hatohobi	163.0	B and C	Protection of fish, turtles, birds, clams and marine habitats. Atoll, patch reefs, channel, lagoon
Ngeruangel Reserve	Kayangel	35.0	C	Protection of fish populations, turtles, birds and marine habitats. Atoll
Ngerukewid Islands Wildlife Preserve*	Koror	11.0	A	Preservation of marine habitat biodiversity and wilderness. Rock islands with important plant, bird and marine attributes, including critical breeding sites for hawksbill turtles and giant clams (70 islands, inner reef flats, lagoon, patch reefs)
Ngerumekaol Spawning Area*	Koror	2.1	B	Protection of reef fish aggregations in Ulong Channel year round. Outer reef wall, reef flat, reef channel
Ngemelis Islands Complex*	Koror	40.0	B	Protection of marine habitat diversity. Sharks, turtles, rays and pelagic fish with link to dive tourism. Rock islands on outer reef, blue holes, reef flats, lagoon, patch reefs
Ngkisaol Sardine Sanctuary*	Koror	0.1	A	Protection of sardine aggregations (goldspot herring, blue sprat and other baitfish). Inner patch and fringing reefs
Ngederrak Conservation Area*	Koror	6.0	A	Protection of dugong, commercial reef fish and invertebrate species populations. Reef flats, inner reef slope, seagrass beds, lagoon

TABLE 3 (Continued)

Name	State	Size (km^2)	Use	Comments
Ngerkebesang Conservation Zone*	Koror	0.1	B	Protection of diverse marine flora and fauna for tourist use close to Palau Pacific Resort. Fringing reef
Rock Islands Southern Lagoon Management Area	Koror	840.6	A, B, C	Protection of marine habitat diversity. Protection of island landforms, fish, invertebrates, turtles and birds
Ngaraard Mangrove Conservation Area	Ngaraard	1.4	A	Protection of mangroves
Ngaraard Beach Conservation Area	Ngaraard	12.1	C	Protection of fish and invertebrates, fringing reef
Ebiil Conservation Area	Ngarchelong	19.1	A	Preservation of grouper spawning aggregations. Reef slopes, reef flats, channel, patch reefs, lagoons
Ngarchelong 'Closure'	Ngarchelong	n.a.	n.a.	Fishing by all non-residents declared *bul* by Ngarchelong within its jurisdiction in 2008
Ngermasech Conservation Area	Ngardmau	3.5	A	Protection of important nursery areas for fish and invertebrate species: rabbitfish, snappers, surgeonfish, giant clams and sea cucumbers. Seagrass beds, fringing reefs
Reef of Ileyakl Beluu (Ileakelbeluu)	Ngardmau	0.5	B	Protection of fish and marine habitats, patch reef
Ngermeduu Conservation Area	Ngeremlengui Ngatpang Aimeliik	167.0	A and C	Protection of marine habitat biodiversity. First UNESCO biosphere reserve in Pacific Islands region. Largest estuary in Micronesia, including mangroves, mudflats, seagrass beds, fringing reefs, reef channel, inner reef flats, reef slope
Ngelukes Conservation Area	Ngchesar	1.0	A	Inshore sea cucumber[a] and fish protection[b] identified in 1999 through a PCS rapid survey. Patch reef
Tululeu Conservation Area	Peleliu	0.8	A	Protection of fish and sea cucumbers. Seagrass area
Ngatpang Conservation Area	Ngatpang	0.5	A	Protection of fish and invertebrates. Fringing reef, seagrass beds
Angaur Conservation Area	Angaur	0.4	A	Protection of fish, invertebrates and marine habitats. Fringing reef
Bkulengriil Conservation Area	Ngeremlengui	0.7	A	Protection of fish and invertebrates. Fringing reef, seagrass beds
Ngerang Clam Area	Melekeok	1.0	C and B	Protection of fish and giant clams. Fringing reef
Airai Reef Conservation Area	Airai	4.0	C	Protection of wetlands and marine habitat diversity and related resource species. Mangrove, seagrass, reef flat and lagoon
Ngerchebal Island Wildlife Conservation Area	Aimeliik	1.0	C	Protection of wildlife on island and surrounding reefs. Island and fringing reef
Melekeok Management Area	Melekeok	n.a.	C	Protection of reef fish. Fringing reef
Trochus Sanctuaries (21 nationwide)	Various	n.a.	C	Protection of important commercial stocks. Fringing and barrier reef

Source: Adapted from Verheij and Aitaro, 2007.
Note: All names denoted with * are within the Rock Islands Southern Lagoon Management Area.
[a] Carmin Pipit, with Palau Community College, studies sea cucumber abundance.
[b] Nestor *et al.*, 2008.

The scale of these MPAs in Palau varies greatly, with the largest being the Rock Islands Southern Lagoon Management Area (hereafter Rock Islands Area), which includes A and B use categories (restricted non-extractive uses and non-extractive uses). The single largest management category area is Helen Reef Reserve, at 163 km^2, although there are open seasons for selected commercial resources. Despite the larger areas under spatial control, there are numerous small reserves in Palau with areas of less than 1 km^2 under no-take management. The smallest MPAs in Palau are found within the Rock Islands Area: the Ngkisaol Sardine Sanctuary and Ngerkebesang Conservation Zone, both with a size of 0.1 km^2. The smallest stand-alone no-take MPA in Palau is the Angaur Conservation Area, with a size of 0.4 km^2. However, these figures are not always good descriptors of conservation status, as some MPAs in Palau often encompass several different levels or types of management, whereas other, traditionally managed areas, which have no designation, support various area and input controls that are not well documented.

3.2 Objective and description of MPAs

In the past, the designation of reserves was generally in response to community concern over declining resources. Community instigation of management controls arose to ensure protection of locally important marine resource populations, although spatial controls were also instituted to respond to the recognized need for conserving sites important to the tourism industry. In few cases were spatial controls driven by biodiversity objectives. It is hoped that the PAN Act of 2003 will encourage the designation of MPAs with a greater biodiversity focus, in order to ensure that a comprehensive, adequate and representative (CAR) approach to MPA planning is achieved, in which all elements of biodiversity are effectively considered, and not just those where species are under heavy fishing pressure.

3.3 Decision processes

Traditionally, relatively decentralized and exclusive tenure systems lent themselves to better maintenance and application of *beluu* (village) controls (Ridep-Morris, 2004). Village councils were responsible for managing public domain, and conservation practices including *bul* and taboos were implemented. *Bul* were instituted by the village *rubak* (traditional chiefs) to help maintain resources.

Legislation protecting species and limiting destructive fishing methods (e.g. the Marine Protection Act of 1994) was not achieving its aim of protecting resources, and spatial controls were seen as a way to improve conservation. After the severe bleaching event of 1998, conservation policy was taken more seriously (Verheij and Aitaro, 2007). There was increased formalization of the rules for *bul*, and a general, Pacific-wide push to implement more-formalized spatial management.

In Palau, traditional spatial controls were often instituted through temporal closures (typically in blocks of three years) and extended if deemed necessary. For example, a reef would be closed for a couple of years to allow it to recover from overfishing, while other areas, such as spawning aggregation sites would be closed for from three to five years. In recent times in Palau, many such closures have become permanent after the lapse of the interim closure. For example, the Ebiil Conservation Area was initially closed for three years, but the closure was made permanent after the first three years of protection expired. In a second case, Ngederrak Conservation Area was initially closed for one year, extended for three years at the end of the first year, and finally closed permanently at the end of that three-year period.

This is not always the case: a *bul* to ban fishing from eight channels, declared in 1994 by chiefs from two states (Ngarchelong and Kayangel), ended after an initial period of successful protection. In 2000, however, a *bul* for one of these eight channels remained (Ebiil and its adjacent reefs), and state legislation supporting the closure followed. Similarly Ngemai Reserve in Ngiwal State, which was closed from 1997 to 2002, was opened again to fishing when the control expired. The process of spatial closures in Palau has typically operated with relatively short time frames, although important areas are now receiving more-permanent protection. Despite this, some areas continue to open and close in a temporal rotation, or have restrictions on resource extraction on a permanent basis for specific times of the year.

Although monitoring of the status of MPAs has been conducted (mainly by NGOs), there is limited quantitative information on the performance of MPAs and their effects on the general environment (Nestor *et al.*, 2008). However, there is still a general community realization that pressures and threats to marine resources and environments are growing, and today there is a greater push to ensure that legislation for spatial controls is in place to protect key reserves in perpetuity.

3.4 Perceptions of MPAs

Community surveys on perceptions of spatial controls have shown that existing MPAs receive high support from community members. For instance, in Ngchesar, 94 percent of community members interviewed supported the state MPA, the Ngelukes Conservation Area (Mersai, 2007). Not only did they support the existing MPA, but 63 percent supported the idea of adding additional areas to the existing no-take reserve (Mersai, 2007). In Ngarchelong, the state with jurisdiction over the Ebiil Conservation Area, 91 percent of the people surveyed supported its establishment, 63 percent supported making it permanent and 60 percent supported establishment of additional MPAs (Palau International Coral Reef Center, unpublished data, 2003). The trend is similar in Kayangel, with 92 percent supporting establishment of the Ngeruangel Reserve, 72 percent supporting making it a permanent reserve and 60 percent supporting establishment of additional MPAs (ibid.). It is interesting to note that while the majority of the people surveyed were not totally supportive of the current management of the existing MPAs, they still supported establishment of MPAs.

One important result reported by Mersai (2007) was that 86 percent of respondents to the Ngelukes Conservation Area survey stated that the reserve should not be permanently closed, but be opened on occasion (e.g. when monitoring data showed there were sufficient stocks for harvesting). This is a recurring theme in the Pacific Islands, with communities often happy to close areas for conservation goals, but once those goals have been attained, seeing little merit in leaving areas untouched. This sentiment is possibly due to a lack of understanding of the potential spillover effects to nearby fishing areas that could arise from leaving MPAs closed for extended periods of time.

The biggest concern of community members is the change in land use affecting coastal areas (Mersai, 2007), and the lack of enforcement or need to improve enforcement at existing MPAs. In Ngelukes Conservation Area, 74 percent of community members recommended strengthening surveillance and enforcement. In Airai State, community visits (villages of Ngetkib and Ngeruluobel) indicated support for the protected areas and for additional MPAs, yet there was a lack of awareness regarding the boundaries or even the existence of areas under protection (A.H. Kitalong, personal communication, 2008). In 2008, boundary markers were placed at these sites and conservation officers in Airai have upgraded their management.

Environmental NGOs also support the establishment of MPAs and most have programmes to promote, strengthen and/or monitor them. The PCS marine programme focuses on building capacity at the community level for better monitoring and management of MPAs, while PICRC's programme concentrates on assessment and evaluation to aid in adaptive management of MPAs. State governments in Palau support the use of MPAs to conserve their resources, and this is evidenced by the fact that 14 of the 16 states in Palau have established at least one (Mersai, 2007). The national government and its agencies also support MPA establishment, particularly after the 1998 coral bleaching incident (approximately 30 percent mortality nationally), which focused government attention on conservation measures (Verheij and Aitaro, 2007), and more recently through the development and institution of the PAN Act. This includes the establishment of a PAN office to support states and communities in the management of their MPAs.

4. MPAs FOR FISHERIES AND CONSERVATION: GOVERNANCE

4.1 MPA legal basis and institutional frameworks (examples of nested institutional involvement)

Prior to the establishment of Palau as a constitutional democracy, some United States federal legislation and Trust Territory legislation were applicable to fisheries and conservation in Palau. However, neither the government nor the Environmental

Protection Board of the time specifically enacted rulings to demarcate and control protected areas. This was despite the introduction in 1975 of an endangered species act that allowed acquisition of land (Public Law No. 6-55), and the availability of various pollution and housing acts, which supported spatial controls.

After Palau's constitutional government was formed in 1981, and it became an independent nation in 'free association' with the United States of America in 1994, there was greater potential for instituting protected areas. The first legislatively recorded perennially protected natural area was established in 1998 (IUCN, 1992). It gave formal protection[3] to the Ngerukewid Islands Wildlife Preserve, which had originally been established in 1956. This reserve of over 70 islands in the south of the main lagoon is one of the longest-standing legislated protected areas in the Pacific Islands region (Idechong and Graham, 1998).

The creation of MPAs in Palau has been a mix of bottom-up (community-initiated) and top-down (government-driven) activity. Before Palau became independent, two MPAs were established using the top-down approach (Ngerukewid Islands Wildlife Preserve and Ngerumekaol Spawning Area), which contrasts with the many cases of bottom-up community-led and comanagement initiatives instituted since Palau's independence in 1994.

The Ebiil Conservation Area is a good example of the nested involvement of institutions in the design and maintenance of reserves. In the north of the lagoon, this reserve was initially an initiative of the chiefs. It was then formally established in 2000 by Ngarchelong State (State Public Law No. 87). Pressure from NGOs and community groups ensured that the area was made a permanent conservation area in 2003. The Ngarchelong state government manages the area with monitoring assistance provided by the Palau Conservation Society and Palau International Coral Reef Center. The Ebiil Society, a community group, works with community members to promote the conservation of resources at Ngarchelong, including the Ebiil Conservation Area, but does not have any formal agreement with the state government to manage Ebiil.

Since Palau became independent and state authority was recognized, there have been a number of state ordinances issued to protect important resource stocks and areas of important habitat. A fuller listing of legal instruments for protection, including related legislation (e.g. the Palau National Code for cultural and sunken resource areas) can be found in Bureau of Natural Resources and Development documents (Bureau of Natural Resources and Development, 1989) and through other agencies (FAO, 2008; IUCN, 1992).

4.2 International MPA-related instruments and international and national benchmarks

The Marine Resources Pacific Consortium (MAREPAC), which comprises representatives from nine island groups in Micronesia (Palau and other United States-affiliated Pacific Islands), develops regional capabilities and collaborations for sustainable use of marine resources. It is funded by the United States Department of the Interior. The MAREPAC's main aim is to adapt traditional management principles and practices to modern resource management challenges.

The Apia Convention for the safeguarding of intangible cultural heritage also provides for the establishment of protected areas. This is one of the oldest conventions in the Pacific, although Palau only became a party in 2009 (with the technical support of the United Nations Educational, Scientific and Cultural Organization [UNESCO]). Palau is also one of the signatories to the South Pacific Regional Environmental Convention, and a member of the Convention on International Trade in Endangered Species (CITES)

[3] Under the Palau National Code, Title 24 (Division 3, Reserves and Protected Areas, Chapter 30, Sections 3001–3004).

of Wild Fauna and Flora. It is part of the Global Island Partnership, which assists islands in conserving and sustainably using their natural resources in support of people, cultures and livelihoods around the world. Palau is a signatory to the Convention on Biological Diversity (since 1999), and a partner in advancing 2010 biodiversity targets. Its PAN Act provides a framework for implementing the Convention's Programme of Work on Protected Areas. Palau also became a contracting party to the Convention on Wetlands (Ramsar Convention) in 2003, and currently has a single site designated as a wetland of international importance (Lake Ngardok Nature Reserve), although this is predominantly not a marine feature.

Other mechanisms are being considered at present, such as UNESCO Man and Biosphere reserves and networks of MPAs. The Ngermeduu Conservation Area is the first biosphere reserve in Palau. It is uncertain how much these international instruments, agreements and legislation are driving the process of marine protection in Palau. However, they undoubtedly help support the process of management by laying out frameworks for adoption, and by stimulating uptake through shared strategizing among regional neighbours. Lastly, the financial assistance gained through these arrangements helps fill the recognized shortfall in funding for work to establish and maintain protected areas.

4.3 Management process

Prior to independence, a conservation officer was hired to work under the Chief of Agriculture for the whole Trust Territory, of which Palau was just a part. Since 1981, management and administration of MPAs has been the responsibility of diverse institutions.

Since their inception, administration of MPAs such as the Ngerukewid Islands has been overseen by both national and state agencies. The Bureau of Marine Resources and the Division of Fish and Wildlife have both played defining roles. In addition, these areas and *Trochus* breeding sanctuaries within them, fall under the active control and protection of the governors of each state (Bureau of Natural Resources and Development, 1989). Despite this multilayered management process, ongoing surveillance and patrolling activities have generally been hindered by a lack of staff and resources. In reality, most of the responsibility for this activity at Ngerukewid Islands falls to a permanent force of marine park rangers, run by Koror State, which is the most populous. Koror manages many key MPAs, using a sustainable financing mechanism based on levies placed on general tourist visitors and divers, which supplements management and surveillance activities for the entire southern lagoon.

In the case of other states, conservation officers are also sometimes funded, although the funding base is more limited. Usually, a state government cannot afford to have a full-time conservation officer, so they also work on other state requirements, for example, public works (Mersai, 2007). State support of a full-time conservation officer usually requires outside funding, often in the form of grants (e.g. the German Government, through the LifeWeb grant, funds a project officer for northern reef management). Many states are now exploring options to be more independent and sustainable. For example, with assistance from the PICRC, Airai State is funding capacity-building and training for its officers. Fuel costs are a major limitation for these officers, and a permit fee system similar to that used in Koror State has been considered.

The passage of the PAN Act means extra funding through the full-time implementation of a visitor levy. Effective 1 April 2009, the Minister of Finance should authorize a US$30.00 environmental protection fee for tourists, of which US$20.00 is to be used for the sole purpose of operating the protected areas network. This 'green fund' is to be managed by an independent non-profit organization and will help support MPA management. From 2005 to 2008, there was a 31 percent increase in visitors from China (Palau Visitors Authority). The rise of affluence in Asia, especially in China, offers

the prospect of greater numbers of incoming tourists, which will directly (the PAN green fund) and indirectly fund the maintenance of MPAs and of Palau's biodiversity heritage, which is a major drawing card for visitors.

4.4 Key challenges

With such a range of national and state bodies legislated to establish controls and manage the marine environment, jurisdiction is blurred (Government of Palau, 1996). The national constitution and the conflicting mandates of government agencies for marine resource conservation and management result in overlapping responsibilities and confusion over jurisdiction, obligations and accountability. In general, most agencies also have insufficient resources to conduct the management tasks required.

As mentioned previously, although marine resource conservation activity in the national interest clearly falls within the purview of the national government (Article IX, Section 5.12), the constitution also states that: "Each state shall have exclusive ownership of all living and non-living resources, except highly migratory fish, from land to twelve nautical miles seaward from the traditional baselines" (Article I, Section 2). Thus agreement is needed to draft clear legislation specifying the rights of each party (Government of Palau, 1996).

Palau's development plan to the year 2020 (Government of Palau, 1996) also recognizes the inadequacy of operating budgets and of surveillance and enforcement capability. Surveillance is minimal in most MPAs and this is reflected in the low rates of prosecution outside of Koror (e.g. only one citation for Ngarchelong in 2008). The Division of Fish and Wildlife has prosecuted several cases in Koror and also in Babeldaob for specific resources, but capacity at the state level is limited. Airai State recently hired officers, who have confiscated catches (rabbitfish and turtles harvested during closed season) and equipment. A well-publicized case in late 2007 saw traditional chiefs of Ngarchelong State impose a fine on a Palauan for operating a commercial fishery in their waters. In this case, 20 foreign fishers employed by the company, using a mother ship and 19 single-engine 'banana boats', were caught by Ngarchelong police with live fish in protected state waters. The commercial fishery owner agreed to pay a US$10 000 fine set by the traditional chiefs.

Successful management of MPAs requires strategic monitoring of ecological assets, in addition to enforcement of reserve controls. Research and monitoring activities for MPAs are usually the preserve of NGOs, and in some cases of the BMR. The BMR has on occasion approached these tasks in partnership with regional agencies (Friedman *et al.,* 2010; SPC, 2008b). The challenge is great: monitoring methods need to be standardized, and feedback of the quantitative results needs to reach park managers and coastal communities. Extra capacity is also needed at the state level to manage and implement changes in response to the results of monitoring and assessments (active adaptive management). In Airai State, researchers have been working to monitor pre-spawning aggregations of rabbitfish, selected invertebrates and mangrove crab and clam (A.H. Kitalong, personal communication, 2008). The focus in Airai has been on community participation and collection of baseline information for the state (Kitalong, 2008).

At this time, only Koror State has a sustainable financing mechanism to support such work. The only way that other states will improve enforcement and management is to find a sustainable financing mechanism, so that management is not dependent on outside donors and grants. The PAN green fund might help address this issue.

4.5 Key incentives and disincentives for implementing MPAs and for collaborating with other institutions in MPA design and implementation

One key outcome often ignored when institutions focus on conservation of resources is the increase in community activity engendered through developing MPA initiatives. The sharing of experience and increased communication and empowerment that result

from developing and managing one's own marine area is felt not only by fishers but also by NGO and state participants. This may result in young community members learning from older fishers, or even researchers sharing monitoring protocols and designs among government and NGO agencies. Such collaborative efforts help reinforce what all agencies are trying to do, although realistic objectives need to be set. Communities and agencies that are overcommitted and have unrealistic time horizons can jeopardize the prospect of a successful outcome. It is important that goals are simple and the time frame sufficient to establish community trust.

5. SOCIO-ECONOMIC AND ECOLOGICAL CONSIDERATIONS AND IMPACTS

5.1 Impacts on fisheries

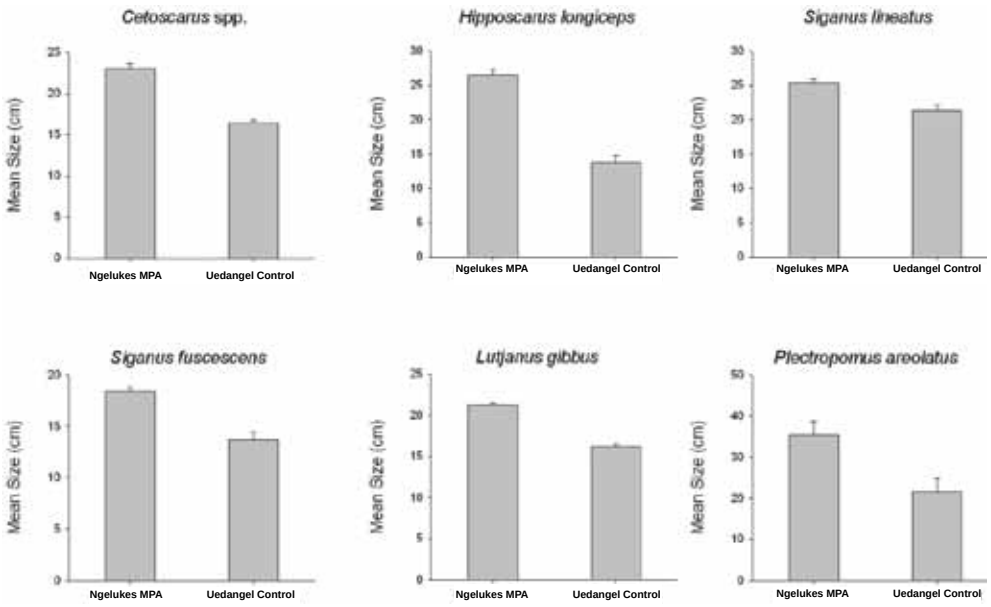
Fishing is a popular activity in Palau. In 2001, 16 percent of the population sold their catch to local fish markets at least once during the year (Government of Palau, 2004). A 2003 survey of subsistence fisheries indicated that 87 percent of households were involved in fishing for subsistence or commercial purposes (Palau International Coral Reef Center, unpublished data, 2003).

In the case of the important and fragile grouper stocks, where spawning aggregations are vulnerable to fishing in channels around the full moon during the May and June spawning periods (Johannes 1981; Johannes *et al.* 1999), the initial implementation of seasonal protection of specific channel areas had an important ongoing conservation effect. For example, at the Ngerumekaol Spawning Area, commercial grouper fishing was primarily prohibited from 1 June to 31 August (Palau National Code, Sections 3101–3103). Koror State then expanded the ban to include all fish and extended the period of protection to the full year (State Public Law No. K6-101-99). It later extended the boundaries of Ngerumekaol Spawning Area to protect pathways for groupers coming into the aggregation (State Public Law No. K6-118-2001). In Ngarchelong State, the Ebiil Conservation Area protected the Ebiil Channel (a spawning aggregation site for groupers) and adjacent reefs (migratory pathways for groupers) to ensure that these key food fish stocks were not targeted when they aggregated to spawn.

In 2002, a socio-economic study showed that 31 percent of fishers perceived that the inshore fisheries were being harvested unsustainably and that catches were at least three times smaller than a decade ago (A.H. Kitalong, personal communication, 2008). Due to this perception and the large amount of reef area that remains open to fishing, there is reportedly a higher level of compliance by fishers in reserves of Palau than is reported for reserves in other parts of the Pacific. However, it is difficult to characterize a single level of compliance across Palau. Koror State has the largest enforcement regime, yet distant states with less ability to monitor their reefs are less populated and thus under less pressure.

Stiff penalties for fishers found in closed areas help decrease the level of poaching from reserves. The Ebiil Conservation Area, predominantly a protection area for groupers, where fishers were fined US$10 000 for poaching, now supports elevated levels of invertebrate stocks such as giant clams (K. Friedman, personal communication, 2008). In the case of the Ngelukes MPA, which was closed in 2002, poaching exists, but is thought to be minimal owing to its proximity to the village. Boats stopping there can be seen by community members. When fish abundance from this area is compared to a control site where fishing pressure is quite high by standards in Palau, PICRC surveys indicate that fish are increasing in number and are more abundant (Nestor *et al.,* 2008; Merep *et al.,* 2008). Fish abundance (mean ±SE) at the Ngelukes Conservation Area was 57.2 ± 10.5, compared with 30.2 ± 4.3 at the control site (Nestor *et al.,* 2008). Not only were there more fish inside Ngelukes MPA, but they were significantly bigger than the fish outside (Figure 3).

FIGURE 3
Average fish size inside an MPA (Ngelukes) and at a control site (Uedangel)



Source: Palau International Coral Reef Center, unpublished data, 2003.

This result is mirrored at the Ngerumekaol Spawning and Ebiil Conservation Areas, where surveys reveal that the three grouper species (*Plectropomus areolatus*, *Epinephelus polyphekadion* and *Epinephelus fuscoguttatus*) accounted for 78 percent of the number and 85 percent of the biomass of all species surveyed, but comprised less than 1 percent of the total number and biomass at control sites (Merep *et al.*, 2008).

In most cases, it is difficult to estimate the spillover effects of MPAs on resource numbers outside the reserve. However, as these results show increased biomass for those fish species that have migrated to aggregations within the MPA to spawn, they are indicative of the status of resources both inside the MPA and on neighbouring reefs that are currently not protected from fishing.

5.2 Critical socio-economic or ecological considerations and socio-economic impacts of MPAs

Fishers are often knowledgeable about habitats and about the natural variations in abundance and size of resource species within them. Community involvement is needed in all phases of management. However, in cases in which fishers are offered compensation for their knowledge and for time devoted to formulating strategies or helping in surveys, the amount of time needed is usually underestimated. It has to be their MPA if long-term goals of conservation are to work, and careful consideration should be given to ensuring that the community is the main driver of the process.

Community involvement is also critical in the sense that enforcement by government agencies is often inadequate. Despite the penalties that can be imposed and the moderate level of pressure, ten of the 16 states of Palau already report problems in enforcing their marine laws, and a further seven report problems with poachers (Government of Palau, 1996). As an example, surveys of turtle nest disturbance at extremely visible reserves such as the Rock Islands Area have found a high degree of poaching. The same is true of the Ngerukewid Islands. This research also notes that although poaching was recorded, the proportion of nests disturbed was less than for nesting areas outside the reserves (Guilbeaux, Davis and Tonne, 1994, cited in Idechong and Graham, 1998).

5.3 The role of the natural and social sciences in design and monitoring

As Palau has a long history of establishing MPAs, it may be time to shift focus to strengthening the management of existing ones, rather than concentrating on designating new MPAs. Natural science can guide the establishment of MPAs and placement, but it is only in partnership with social science that MPAs will continue to have success. The PICRC MPA research programme focuses on both ecological and social studies to assist states and communities in identifying weaknesses in and constraints on current management, so that steps can be taken to improve MPA management (Mersai, 2007).

In Airai, work has focused on collecting baseline information with community groups and then asking participants to share this information with the villages (A.H. Kitalong, personal communication, 2008). Community members see for themselves the changes that no graphs or charts can effectively replace. Elders share information with young people and the community about declines in their favourite fishing areas, and in a village setting this style of awareness-raising is powerful.

6. COORDINATED APPROACHES TO MPAs FOR FISHERIES MANAGEMENT AND CONSERVATION

6.1 MPAs embedded in other fisheries management on a larger spatial scale

The signing of the PAN Act into law by the Palau National Congress offers scope for the dual objectives of protecting biodiversity and natural resource management. This is predominantly a state-based system, supported by national government (Verheij and Aitaro, 2007). It provides a framework for Palau's government agencies to collaborate in establishing a resilient nationwide network of terrestrial and marine protected areas. Recent assessments of the current distribution of MPAs indicate that they adequately serve biodiversity goals, despite being established with resource conservation in mind. When the current MPA layout was overlaid onto biodiversity priority maps, existing MPAs (of which 26 were established with a natural-resource management objective) were well distributed over biodiversity priority areas (Hinchley *et al.*, 2007; Verheij and Austin, 2008).

6.2 Examples of links to fisheries management

The Government of Palau (1996) states that reserves are seen as an alternative to catch and effort controls and are proving successful in protecting stocks of large fish. Ongoing monitoring to assess the efficacy of several MPAs by the PICRC and the PCS (with the TNC) is highlighting the protection and decline of some key resource species. In Ngelukes Conservation Area, for example, fish abundance and sizes are much higher than in adjacent control sites. In Ngerumekaol and Ebiil, the abundance of groupers is much higher than in non-protected channels, and in Ngeruangel, fish such as parrotfish and snappers are much bigger than in the control site. Regarding invertebrates, giant clams are also much more abundant in Ngeruangel Reserve than in the non-reserve Kayangel. The same result is registered in Ngarchelong, at the Ebiil channel.

Results on the increase of fish at Ngelukes, Ngerumekaol, Ebiil and Ngeruangel help reveal the depleted status of resources and habitats in fished areas across Palau. In addition to detecting these resource depletions, the PICRC is currently looking at a more holistic picture of conservation management by considering watershed issues and links between land and marine management authorities, in order to ensure that effective land-use regulations manage downstream effects on coastal systems. This has led to communities taking action to decrease the amount of sediment flowing to lagoons from watersheds and placing a moratorium on the cutting of mangroves (Richmond *et al.*, 2007). For example, Airai State stopped leasing mangrove areas and passed a state law "to protect, conserve, and manage the cutting and/or harvesting of the trees and vegetation below the high tide line, in mangroves, wetlands, and marine and coastal areas" (Public Law No. A-5-01-07).

Regional comparisons of the status of resources and habitats are also possible through DMR activity. In collaborative studies with the SPC, the BMR recently participated in a comparative assessment across 17 countries and territories in the Pacific (the four sites selected in Palau were Ngarchelong, Ngatpang, Koror and Airai). This presents quantitative data on the comparative high status of resources in Palau compared with other countries in the Pacific (Friedman *et al.*, in press).

6.3 Institutional overlap

There are a number of overlaps between institutions working on designing, implementing and managing fisheries spatial controls in Palau. In the field, community groups have had success in liaising with each other. For example, the institution of the Ngermeduu Conservation Area used a multiple-community approach, requiring that people from three states be involved in preparing the nomination. This MPA protects mangroves, mudflats, seagrass beds, fringing reefs, reef channels, inner reef flats and reef slope across state boundaries, including crab, fish and clam species that are economically important to a number of communities.

Equally complicated is the overlap of formal government agencies and NGOs managing MPAs. The Ngerukewid Islands Wildlife Preserve is a good example, as this MPA is protected under both the Palau National Code and Koror State zoning laws, with additional legal instruments working in parallel. The enabling legislation states that the preserve is to be retained "in its present primitive condition where the natural plant and animal life should be permitted to develop undisturbed". Problems in managing this MPA and reserves in neighbouring Rock Islands are complicated by the multilevel approach, including a state border dispute between Koror and neighbouring Peleliu State. In some cases specific memoranda of understanding (MOUs) are developed. For example, Koror State has an MOU with the national Division of Fish and Wildlife to protect nesting turtles, while Airai and Ngchesar are currently both managing a conservation area along their common border.

In practice, the overriding institutional overlap in Palau is between national and state agencies. As mentioned previously, the BMR, Palau Fishing Authority, national Division of Fish and Wildlife, the Ministry of Justice, and the relevant state governments all have responsibilities for implementing policies to conserve marine coastal resources and environments.

6.4 Challenges and opportunities

Palau still has much work to do to rationalize agency controls of its inshore environment – and to strengthen its basic fisheries management by registering commercial fishers that operate in coastal areas (Koror is the only state to have a boat registration act). In addition to an understanding of fishing activity, greater surveillance and enforcement is needed of legislation already in place.

Palau has a vulnerable economy, with aid currently comprising 20.6 percent of GDP (Hanich and Tsamenyi, 2009) and with the funding period for the Compact of Free Association Agreement with the United States of America having reached completion (1994–2009). With this change, there is likely to be a decline in work opportunities and income for the people of Palau. This, and the prospect of greater capacity of Asian markets for marine products, is likely to mean increased pressure on marine resources. Such a scenario will require greater efforts from management, and more vigilant enforcement of compliance, with greater protection of MPAs in particular. Developers are projecting increases of over 300 000 visitors from China, with proposed charter flights in the near future. To date this has not been realized, and the increase in visitors has been manageable.

7. FUTURE DIRECTIONS

7.1 Institutional collaboration for better design, implementation and stakeholder participation

Palau has some of the best baseline data of any Pacific Island country on the status of its reserves. It also has a highly regarded framework of spatial and other management controls to work with, which will help ensure good biodiversity outcomes for the future. Communities, NGOs and government authorities need to continue collaboration in identifying gaps in the current conservation approach and in implementing a more strategic CAR approach to biodiversity protection.

In 2005, the then-President of Palau, Thomas Remengesau Jr, committed his nation to preserving 30 percent of their nearshore marine resources and 20 percent of their terrestrial resources by 2020. This '2020 Micronesia Challenge' is supported by the new President of Palau, Honourable Johnson Toribiong, and a further four Micronesian governments (the Federated States of Micronesia, Republic of the Marshall Islands, Guam and Commonwealth of the Northern Mariana Islands). Spanning 6.7 million km^2, the Micronesia Challenge represents more than 5 percent of the Pacific Ocean and 61 percent of the world's coral species. It includes 66 threatened species, more than 1 300 species of reef fish, 85 species of birds and 1 400 species of plants, 200 of which are found only in Micronesia (Hinchley *et al.,* 2007). The key now is to ensure implementation of these goals and to upgrade management of the MPAs already legislated.

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