

# The State of Coral Reef Ecosystems of the Federated States of Micronesia

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## INTRODUCTION AND SETTING

The Federated States of Micronesia (FSM) is comprised of 607 islands found within four states. From east to west, Kosrae, Pohnpei, Chuuk and Yap span 1.6 million km<sup>2</sup> of the western Pacific Ocean from 1.0–9.90 N longitude and 138.2–162.60 E latitude (Figure 13.1). Each island or group has its own language, customs, local government and traditional system for managing marine resources. The FSM has a total landmass of 702 km<sup>2</sup> comprised of both high islands and atolls, with land elevation ranging from sea level to about 760 m (2,500 ft; FSM National Biodiversity Strategic Action Plan, 2003). Trade winds prevail from December through April, with periods of weaker winds and doldrums occurring from May to November. Rainfall is extremely high on the high volcanic islands of Kosrae, Pohnpei and Chuuk, and can exceed 10 m (400 in) a year (South Pacific Regional Environment Programme, 1993; Lindsay and Edward, 2000). The islands support three basic reef formations: fringing reefs, barrier reefs and atolls (U.S. Army Corps of Engineers, 1985; USACE, 1986; USACE, 1987; USACE, 1988; USACE, 1989a; USACE, 1989b). Islanders have a strong dependence on coral reefs and marine resources, both economically and culturally (Falanruw, 2004; FSM, 2004; FSM, 2003; The Nature Conservancy, 2003).

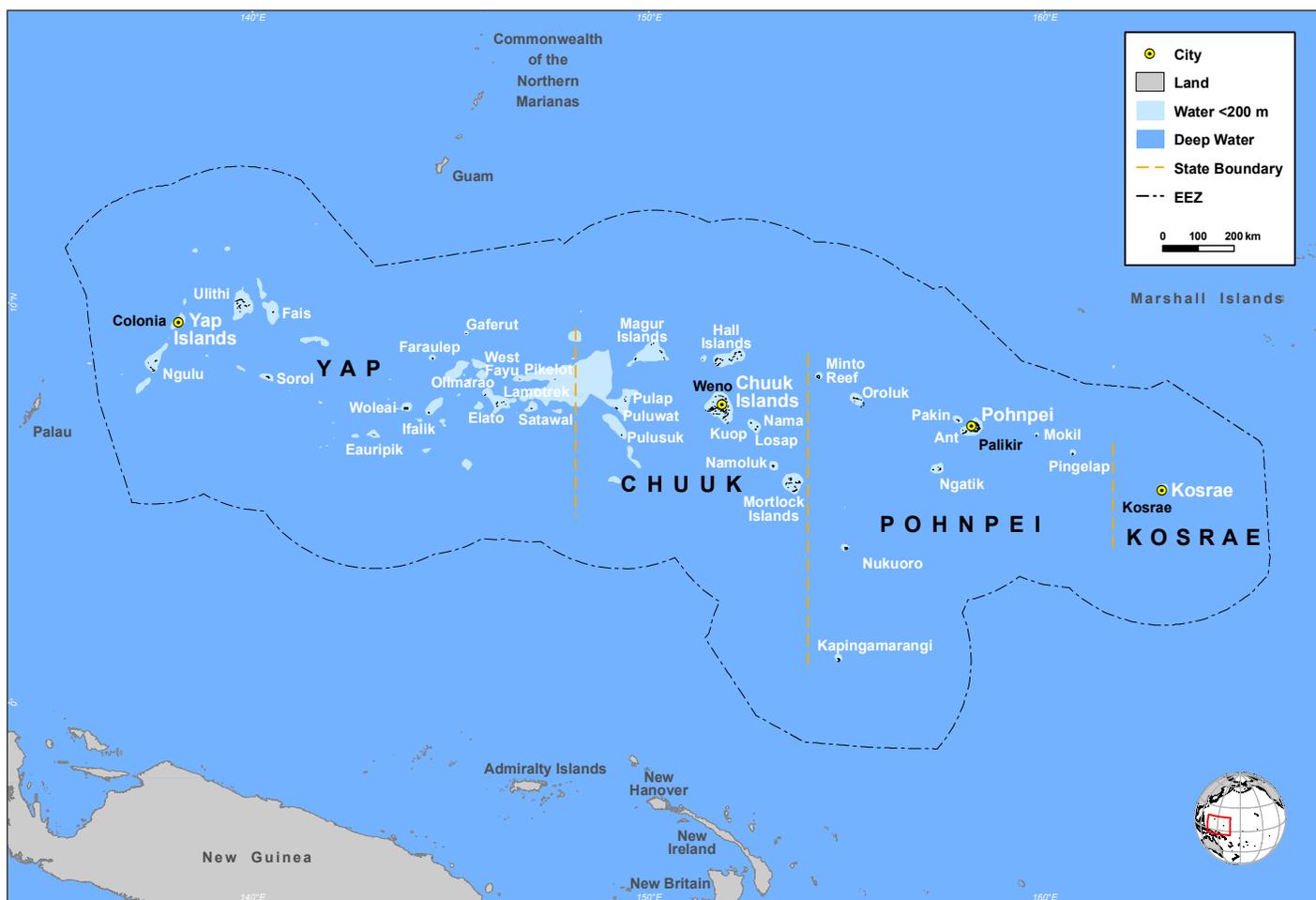


Figure 13.1. Locator map of FSM showing state boundaries and the FSM Exclusive Economic Zone. Map: K. Buja.

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|--------------------------------------------------------------|-------------------------------------------------|
| 1. Kosrae Conservation and Safety Organization               | 9. Yap Community Action Program                 |
| 2. Conservation Society of Pohnpei                           | 10. Yap Marine Resource Management Division     |
| 2. Kosrae Marine Surveillance Division                       | 11. Yap Environment Protection Agency           |
| 3. Kosrae Reef Protection Community Action Committee Partner | 12. Micronesia Conservation Trust               |
| 4. Conservation Society of Pohnpei                           | 13. FSM Department of Resources and Development |
| 5. Pohnpei Marine Conservation Unit                          | 14. The Nature Conservancy Micronesia Program   |
| 6. Chuuk Conservation Society                                | 15. NOAA Coral Reef Conservation Program        |
| 7. Chuuk Department of Marine Resources                      |                                                 |
| 8. Chuuk Environment Protection Agency                       |                                                 |

The state of Kosrae is a single volcanic island with a land mass of 109 km<sup>2</sup> and a maximum elevation of 629 m. Kosrae is surrounded by a fringing reef and has three harbors. In areas where the reef flat is wide, there are a number of large solution holes, some of which support extensive coral development (USACE, 1987). The reef is narrow along the east and south coasts, but nearly wide enough along the west and north coasts to be considered a barrier reef. The island is surrounded by coastal mangrove forest and extensive fringing reefs. Kosrae's reefs and mangroves are considered some of the healthiest in Micronesia (Donaldson et al., 2007) and support a small but growing SCUBA diving and ecotourism industry. However, recent coastal development and land use patterns have resulted in some coastal erosion and degradation of the coastal mangrove ecosystem, placing the health of Kosrae's reefs at risk (Maragos, 1993).

The volcanic island of Pohnpei, the site of the FSM capital, is the largest island in the FSM (345 km<sup>2</sup>) and along with eight smaller islands and atolls, makes up the state of Pohnpei. Pohnpei Island has a well-developed barrier reef and associated lagoon (Figure 13.2). Pohnpei has outstanding biological significance. It is one of the few central Pacific high island "bridges" that enabled marine and terrestrial life to migrate from the Indo-Malay region into the Pacific. This characteristic, along with its geographic isolation, has resulted in high levels of species diversity and endemism (FSM NB-SAP, 2003). Pohnpei's extensive reefs and lagoon feature a wide diversity of productive and relatively intact natural habitats, including barrier reefs, fringing reef flats, reef passages, seagrass beds and mangroves. These habitats support a remarkable abundance of marine life, including more than 650 species of fish and nearly 350 species of coral (Allen, 2005; Turak and DeVantier, 2005). Pohnpei boasts the world's lowest dwarf cloud forest at 450 m elevation. Pohnpei's Nanmeir en Salapwuk Valley holds what is considered to be the largest intact lowland tropical forest in the Pacific outside of Hawaii. The people of Pohnpei, like those in many developing Pacific nations, depend on marine resources for subsistence and cash income.



Figure 13.2. Pohnpei, the largest island in the FSM, is the country's political and administrative capital; Pohnpei's well-developed barrier reef and expansive lagoon encompass marine habitats that support abundant marine life. Photo: J. Waddell.

The state of Chuuk is made up of five island regions: Chuuk Lagoon, Mortlocks, Pattiw, Halls and Nomunweito. The state makes up half of the total FSM population (Figure 13.3), and the Chuukese people are highly dependent on the marine environment for subsistence. Although Chuuk has extensive coral reef resources (TNC, 2003), it has very limited economic resources. Chuuk Lagoon is the largest atoll in the FSM and serves as the population and political center of Chuuk State.

Yap State contains four main islands known as Yap Proper or Wa'ab, with a land area of approximately 100 km<sup>2</sup>, and an additional 15 islands and atolls. The lifestyle of Yap islanders is among the most traditional in the FSM, with a highly sophisticated marine tenure and marine resource management system (Smith, 1994). The Yap outer islands consist of three raised coralline islands and 12 coral atolls. Two of the raised islands (Fais and Satawal) and nine of the atolls (Ngulu, Ulithi, Sorol, Eauripik, Woleai, Ifaluk, Faraulep, Elato and Lamotrek) are inhabited. The fringing reef surrounding Wa'ab is broad and mostly shallow (<3 m) but in some places reaches depths >10 m (Orcutt et al., 1989).

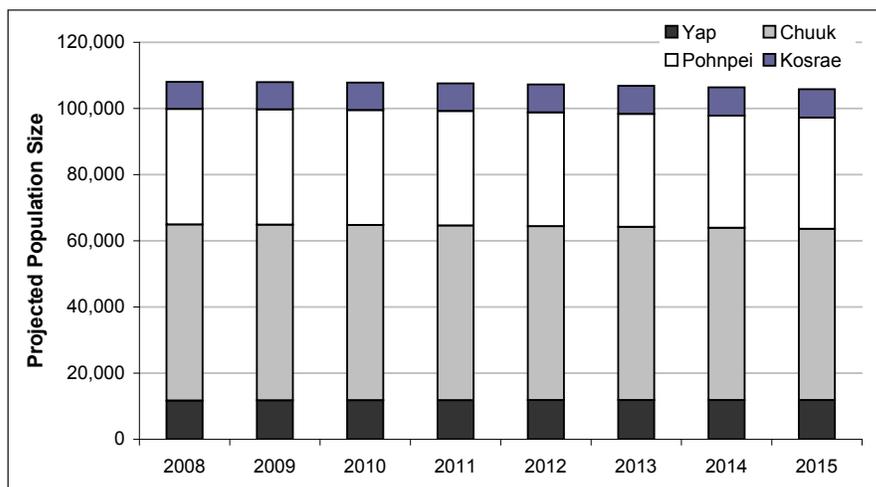


Figure 13.3. Projected population size, by state, from 2008-2015. Chuuk is projected to continue to make up half of the FSM population. Source: FSM Division of Statistics, <http://www.spc.int/prism/country/FM/stats/>.

## ENVIRONMENTAL AND ANTHROPOGENIC STRESSORS

### Climate Change and Coral Bleaching

Only one major coral bleaching event has been recorded in Kosrae in the past. In 2004, *Acropora* species in front of the Kosrae Phoenix Resort on the northeast coast were observed to be bleached. Other than this localized event, there has been very little coral bleaching reported in Kosrae. Instances of coral bleaching in Kosrae are believed to have been caused by increases in sea water temperatures. A minor and localized coral bleaching event involving *Acropora* species was observed at the northeastern barrier reef of Pohnpei in 2004, but the corals were fully recovered by 2005. Since then there have been no reports of coral bleaching in Pohnpei. According to preliminary results from the Yap rapid ecological assessment (REA) that took place July 11–August 2, 2007, some coral bleaching was seen on the reef flats of Ngulu and Ulithi Atolls, and there is evidence of a possible bleaching event resulting in some mortality at Ngulu Atoll that may have occurred more than 10 years ago (E. Turak, pers. comm.).

### Diseases

The number of incidences of disease in the corals of Kosrae is quite small and within normal range. Although coral disease is also quite rare in Pohnpei, monitoring for diseases still needs to be incorporated into the coral monitoring plan.

### Tropical Storms

Tropical storms frequently pass through or near the FSM. Although there have not been any destructive storms in the past three years, in early 2004 Typhoon Sudal passed by Chuuk and directly hit Yap, causing structural damage to reefs (Figure 13.4). The recent effects of tropical storms on corals in Kosrae appear to be minimal, and no data are available for Pohnpei, Chuuk or Yap.

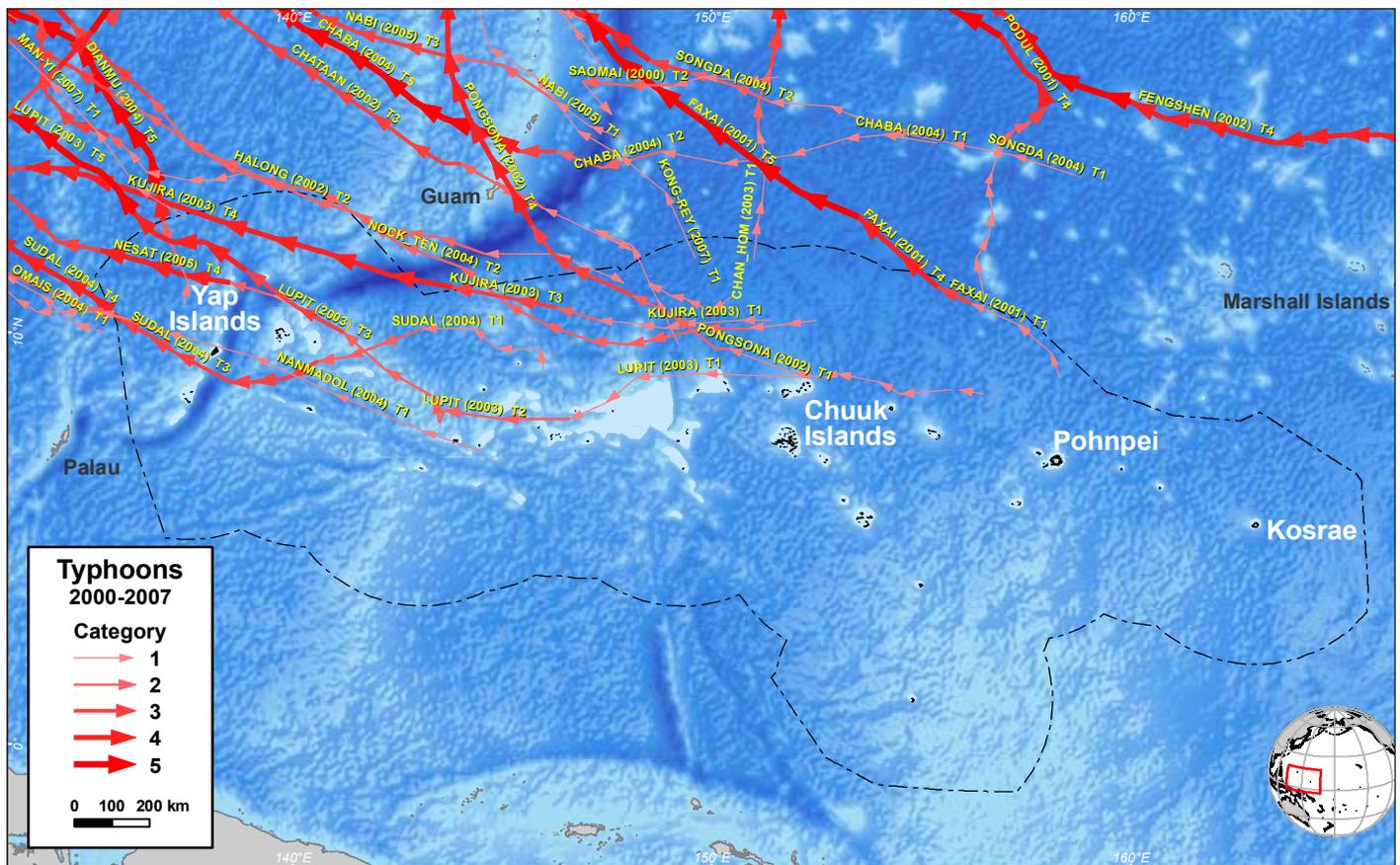


Figure 13.4. The path, intensity, year and name (when available) of typhoons passing near the FSM from 2000–2007. Many Pacific typhoons are not named or the names are not recorded in the typhoon database. Map: K. Buja. Source: <http://weather.unisys.com/hurricane/>.

### Coastal Development and Runoff

Over the past 20 years the availability of large amounts of funding for infrastructure improvements under the Compact of Free Association with the U.S. has led to increased dredging, road construction and land clearing. For example, in fiscal year 2007, \$6.1 million was allocated to the Infrastructure Sector (<http://www.doi.gov/oia/Firstpginfo/compactgrants/index.html>). Sedimentation from these land-based activities, as well as agriculture, has contributed to the degradation of nearshore coral reef ecosystems in all four states (TNC, 2003). Coastal development is the lead cause of soil erosion and sedimentation in Kosrae. The construction of the circumferential road to connect Utwe and Walung exacerbates the impacts of

soil erosion and sedimentation on the corals along Kosrae's southern reefs. Housing developments for residential and business purposes along the coast also contribute a great deal to the problem of sedimentation. Coastal development is one of the biggest stressors to the coral reefs of Pohnpei as well, with more than 50 dredge sites and mangrove clearings (man-made channels) surrounding the coast. According to Yap Environmental Protection Agency (YEPA), large volumes of dredged coralline materials (50,000-150,000 yd<sup>3</sup>/ project) are regularly used for construction projects (Figure 13.5).

### Coastal Pollution

Construction of pipelines and placement of sewage outfalls near coastal areas and rivers in Kosrae affect the health of corals. Landfills within mangrove areas and the conversion of mangroves into dump sites are major contributors to coastal pollution as well. In Pohnpei, coastal pollution is localized mostly at river mouths and estuaries. Poor land use practices and inadequate waste management are resulting in the accumulation of solid wastes on shorelines that eventually make their way into the lagoon.

### Tourism and Recreation

Overall, the number of tourists visiting the FSM has remained relatively steady since 2002 (Figure 13.6). Kosrae receives relatively few tourists each year. The few that visit Kosrae come primarily to enjoy diving and snorkeling as well as canoe rides within the mangrove channels of Utwe and Walung. These tourists are amongst the most environmentally conscious in the world. As a result, the impacts from the tourism industry on the corals in Kosrae are minimal.

### Fishing

Overfishing has been identified as the most urgent and critical threat across biologically significant marine areas in all states (TNC, 2003). Both population growth and a shift from subsistence to commercial harvest over the past 30 years have put pressure on FSM's coral reefs (Figure 13.7) despite an overall decline in the number of people employed in the fishing industry (Figure 13.8). The breakdown of traditional management systems throughout Micronesia has also contributed to overharvesting (Smith, 1994). In Kosrae, destructive fishing methods that are commonly used by fishermen impact fish populations much more than the corals. Poisonous roots and bleaches are used on the reef flats and within the lagoon to kill



Figure 13.5. Dulkan dredge site in Yap. Photo: L. Johnson.

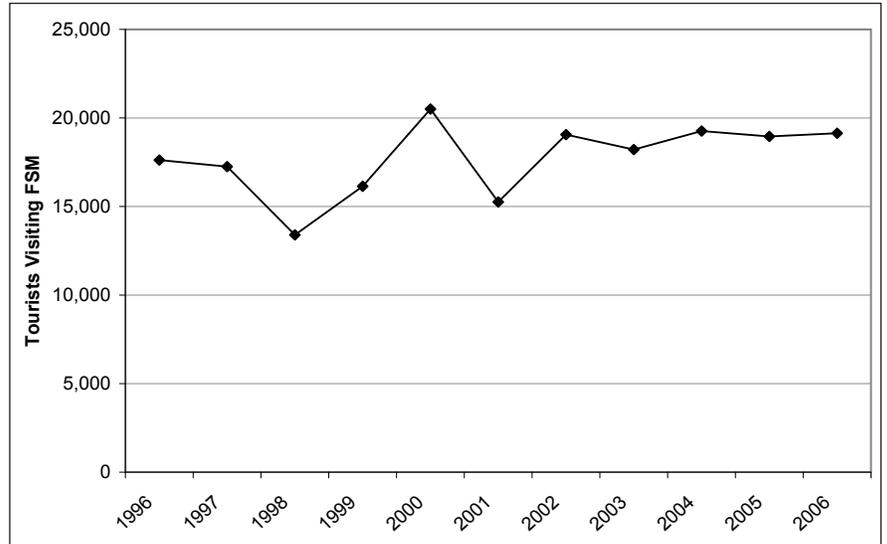


Figure 13.6. The number of international tourists visiting the FSM from 1996-2006. Source: FSM Division of Statistics, <http://www.spc.int/prism/country/FM/stats/>.

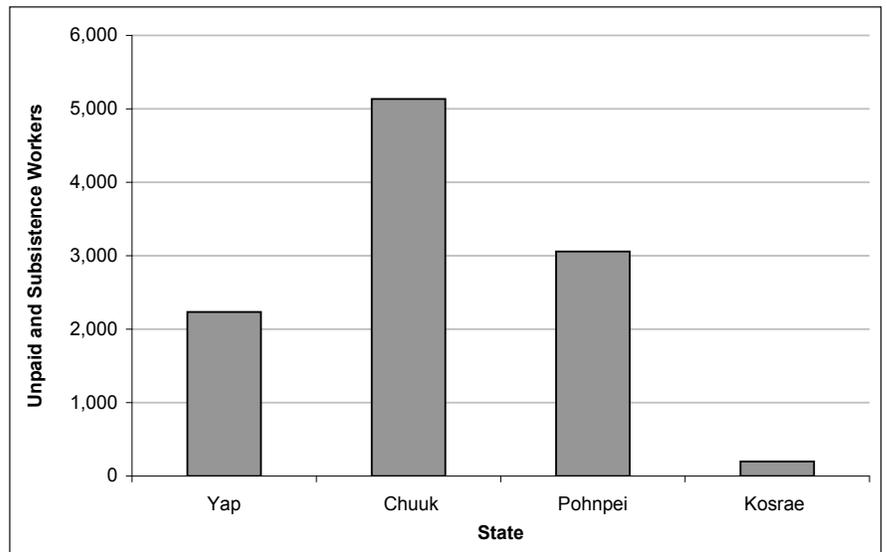


Figure 13.7. The number of unpaid or subsistence workers across the FSM. Source: FSM Division of Statistics, <http://www.spc.int/prism/country/FM/stats/>; 2000 FSM Census.

large numbers of fish. Dynamite fishing is not commonly used, but net fishing is common in Kosrae (Figure 13.9).

In Pohnpei, a market-based analysis was conducted in 2006 by the Conservation Society of Pohnpei (CSP) in conjunction with ongoing ecosystem assessment efforts in order to determine the condition of Pohnpei's reef fisheries. Both concluded that the reef fish populations in Pohnpei are being overfished and that present harvest levels are unsustainable. Without an overarching policy that combines habitat protection and fishery management practices, Pohnpei's fishery resources are likely to continue to decline dramatically. The market-based analysis indicated that at a minimum, 2,500 lbs of reef fish are being sold daily at local markets (approximately 1,000,000 lbs per year). These estimates do not include subsistence catch, fish sold to schools and hospitals, or exports. If estimates of these catches are taken into account, it is likely that the amount of fish taken from Pohnpei's reefs exceeds 4,000 lbs daily (approximately 1,500,000 lbs annually). Lack of a current policy to regulate size limits and sales, and an undervalued market price are all significant factors contributing to the overfishing problem. Market-based analysis indicated that at least 70% of all the fish sold at markets are immature fish. Removal of adult female fish with eggs further reduces opportunities for replenishment of reef fish populations. Also, the study indicated that spear fishing at night, which is the most popular type of fishing, gives an unfair advantage to the fishermen and contributes to the overall decline in reef fisheries. Pohnpei fishermen predominantly target four families of reef fish: unicorn fish, grouper, parrotfish and jacks. When seasonal bans are in effect for groupers (March and April), more parrotfish are recorded in the markets.

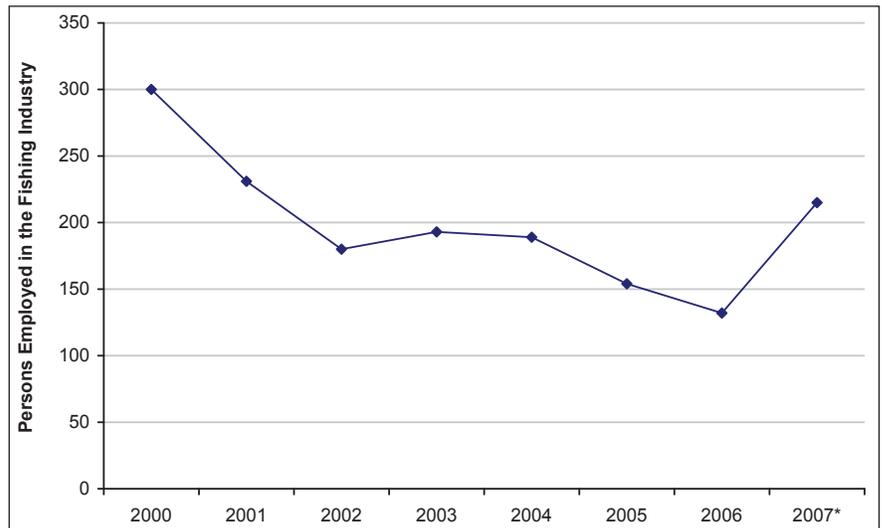


Figure 13.8. The number of persons employed by the fishing industry in the FSM between 2000 and 2006. An asterisk (\*) indicates a projected value. Source: FSM Division of Statistics, [http://www.spc.int/prism/country/FM/stats/Economic/LMrkt/LMrkt\\_FY07est.pdf](http://www.spc.int/prism/country/FM/stats/Economic/LMrkt/LMrkt_FY07est.pdf).



Figure 13.9. Women net-fishing in Kosrae. Photo: K. Adams.

#### Trade in Live Coral and Live Reef Species

As of 2006, there was still no local market for trade in live coral and reef species in Kosrae. However, in 2006 a foreign investment permit was issued for live coral exportation for the aquarium trade. The project has not begun yet as it awaits a development permit from the Kosrae Island Resource Management Authority.

According to preliminary results from the Yap REA sites, broken and dead coral were observed at Ngulu Atoll. The damage was believed to be associated with illegal cyanide fishing for large Napoleon wrasse (*Cheilinus undulatus*) captured stunned but alive by foreign fishing vessels (E. Turak, pers. comm.).

#### Ships, Boats and Groundings

In the past three years, there were no incidents of ship or boat groundings in Kosrae. However, some boats have grounded on reefs in the other states, such as at Elato Atoll in Yap (Figure 13.10). According to preliminary results from the Yap REA, a large swath of physical damage on a patch reef in Ngulu Atoll may have been the result of a ship grounding that occurred within the past several years (E. Turak, pers. comm.). However, recovery of the area was expected, as many coral recruits approximately 3-5 years old were observed (E. Turak, pers. comm.).

### Marine Debris

Locally generated marine debris is another threat that is affecting Kosrae's marine ecosystem. However, environmental awareness campaigns to remove debris have been carried out by conservation agencies and organizations on the island.

### Aquatic Invasive Species

In 2005, the Bishop Museum sponsored a workshop in the FSM focused on aquatic invasive species. The workshop provided an overview of the impacts of certain aquatic species in the region and eradication measures that have been taken to date (L. Eldridge, pers. comm.). Currently the impacts of aquatic invasive species in the FSM are unknown. However, preliminary findings from the Kosrae REA identified an invasive corallimorph (*Rhodactis howsii*) at one of the sites surveyed in 2006 (Donaldson et al., 2007).

### Security Training Activities

No security training activities currently occur in the FSM.

### Offshore Oil and Gas Exploration

No offshore oil and gas exploration currently occurs in the FSM.

### Other

#### *Crown-of-thorns Sea Star (Acanthaster planci)*

An infestation of *crown-of-thorns sea stars* (COTS) in 1994 resulted in coral mortality along the western side of Kosrae. An eradication project was implemented and carried out by the Marine Resources Division and dive operators on the island. During coral monitoring surveys in Pohnpei, COTS were found to be widely distributed and present in densities approaching outbreak levels (Figure 13.11). Continuing predation by COTS appears to be altering the structure of coral communities (Turak and DeVantier, 2005).



Figure 13.10. Removing oil from a grounded vessel on Elato Atoll in Yap. Photo: L. Johnson.



Figure 13.11. A COTS eating *Porites* in Pohnpei. Photo: E. Turak.

## CORAL REEF ECOSYSTEMS—DATA-GATHERING ACTIVITIES AND RESOURCE CONDITION

Each state in the FSM has two government regulatory agencies that manage coral reef ecosystems: Marine Resources Divisions (MRD) and Environmental Protection Agencies (EPA). The local non-governmental organizations (NGOs) focused on coral reef conservation in each state, including Yap Community Action Program (YapCAP), Chuuk Conservation Society (CCS), Conservation Society of Pohnpei (CSP) and Kosrae Conservation and Safety Organization (KCSO), also work with government agencies and local communities to protect and monitor coral reef resources. Regional organizations such as the Secretariat of the Pacific Region Environmental Programme (SPREP) and The Nature Conservancy (TNC) offer technical and financial assistance for reef-related programs. Additionally, U.S. Peace Corps volunteers in the FSM assist local counterparts in government agencies, NGOs and local communities as part of the Natural Resource Conservation and Development program.

The four states of the FSM are at different stages of development and implementation of coral reef monitoring programs. Some individual monitoring efforts have been in effect since 1994 (Table 13.1), but recently the FSM has started to develop and implement a more standardized monitoring program across the country. Because coral ecosystem monitoring is at such an early stage in FSM, all monitoring results are grouped by state instead of by the standard data categories of water quality, benthic habitats and associated biological communities.

Table 13.1. Monitoring efforts across the FSM.

PROGRAM	OBJECTIVES	START DATE	FUNDING	PARTNERS
Kosrae Fish Monitoring Program	Assess stocks of commercially important food fish in Kosrae.	2000	NOAA, KSG	KDMS
Kosrae Marine Monitoring (Reef Check)	Monitor the status of the reefs of Kosrae to assess changes in coral, fish and invertebrates over time (monitoring sites increased from six to ten in 2000).	1994	KSG, Sea Grant, Kosrae Village Resort and Volunteer Divers, NOAA	KDMS, KVR, KCSO
Pohnpei MPA Monitoring Program	Monitor important fishery species for five MPA sites within Pohnpei lagoon. Apply CSP's established fishery monitoring protocol to newly established MPA's within the network. Continue a coral and benthic habitat monitoring program established in 2004/2005. Continue monitoring of a multi-species, Serranid spawning aggregation inside the Kepahara MPA..	2003	NOAA, DOI-OIA, Packard Foundation	CSP, PMRD
Yap State Coral Reef Monitoring Program	Establish a monitoring program with simple, realistic methods. Establish a working network among agencies in Yap and in the region for collecting, processing, and sharing monitoring information. Collect and use baseline monitoring data to promote and technically support conservation efforts at the community level.	2006	NOAA, Yap State	YapCAP, YEPA, YMRMD,
Chuuk Coral Reef Monitoring Program	Under development.	Planned to start in 2008	NOAA, Chuuk State, MCT	CCS, CEPA, CMRD

CCS = Chuuk Conservation Society  
 CEPA = Chuuk Environmental Protection Agency  
 CMRD = Chuuk Marine Resources Division  
 CSP = Conservation Society of Pohnpei  
 KCSO = Kosrae Conservation and Safety Organization  
 KDMS = Kosrae Division of Marine Surveillance  
 KIRMA = Kosrae Island Resource Management Authority  
 KSG = Kosrae State Government  
 KVR = Kosrae Village Resort Ecolodge  
 MCT = Micronesian Conservation Trust  
 PMRD = Pohnpei Marine Resources Division  
 YapCAP = Yap Community Action Program  
 YEPA = Yap Environmental Protection Agency  
 YMRMD = Yap Marine Resources Management Division

From 2005 to 2007, the Palau International Coral Reef Center (PICRC) and the National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation Program sponsored annual coral reef ecosystem monitoring workshops to build monitoring capability within Micronesia. Rob van Woessik from the Florida Institute of Technology conducted these trainings which focused on coral and fish taxonomy, reef sampling methods, experimental design, statistical analyses, data management and reporting to local and state agencies. Participants from Yap, Pohnpei, Kosrae and Chuuk attended the workshops. Ongoing coordination efforts will continue to support the first regionally-coordinated monitoring program within Micronesia. This monitoring program has been an international collaboration supported by NOAA, PICRC, the FSM Government, the Japanese International Cooperation Agency, the Marine Resources Pacific Consortium, TNC, government regulatory agencies and NGOs of Micronesia.

## Kosrae

The Division of Marine Surveillance (DMS) under the Department of Agriculture, Land and Fisheries is the lead agency that monitors Kosrae's coral reef ecosystems, with the assistance of KCSO and the Kosrae Village Ecologde. Financial support from the U.S. Department of Interior made it possible to implement a REA in 2006. In addition, staff from DMS and KCSO participated in coral reef ecosystem monitoring workshops held in Palau and sponsored by NOAA.

The status of Kosrae's reefs is monitored annually at five permanent coral monitoring sites with an additional proposed site at a patch reef within Lelu harbor (Figure 13.12). The purpose of the coral monitoring program is to detect possible changes in benthic cover and the abundance of fish, and identify factors that may disturb the health of Kosrae's coral reef ecosystem. A diverse number of benthic habitats are found within the coral reef ecosystem of Kosrae, and it is estimated that there are more than 200 species of coral (Donaldson et al., 2007). A total of 38 species of algae have been documented in Kosrae (USACOE, 1989a).

Kosrae is a steep volcanic island with high annual rainfall. Road construction, home development and land clearing are major sources of erosion and sedimentation which impact coral reefs. Based on the preliminary findings of the 2006 REA, turbidity is quite high in Okat, Utwe Bay and Lelu Harbor, especially in areas where streams and river mouths are located (Donaldson et al., 2007).

The only method that has been used by the Kosrae state coral monitoring team to carry out its monitoring activities is the Reef Check Method ([http://reefcheck.org/conservation/long\\_term\\_monitoring.php](http://reefcheck.org/conservation/long_term_monitoring.php)). The following data are collected during each survey:

- Benthic cover at every half meter along an 80 m transect, using the line intercept method.
- Fish counts, targeting specific indicator species along a 5 m x 5 m x 80 m belt. The fish counter takes 12 minutes to swim each of the 20 m replicates.
- Invertebrate counts target indicator species along the same belt transect.
- Environmental data including wind speed and direction, cloud cover, air temperature and water temperature at the surface and at depth, and horizontal visibility.
- A water sample is collected for an analysis of salinity.
- Additionally, the environmental data collectors swim through the transect line for an overall picture of coral condition, damage, existence of marine debris, etc.
- Site information, such as the nearness of various pollution sources, amount of fishing and diving activities and the use of destructive fishing methods, is also recorded.

Traditionally, under the Reef Check protocol, transect lines are put out and then there is a 20-30 minute wait for the fish to come out of hiding. Our experience has been that while this works well with the smaller fish, larger species tend to move away from transect lines and are not counted. Beginning in 2007, the fish counter swam with the person laying out the line to record the presence of large fish. After the fish counter completed the first half of the transect, the coral, invertebrate and environmental data recorders enter the water to begin their work. Finally, the data are entered into a database, where they are analyzed and published in the Reef Check annual report.

Currently there are two separate coral monitoring programs underway, both using Reef Check protocols. Kosrae MRD and KCSO survey five sites twice per year. A program organized by the Kosrae Village Ecologde utilizes sport divers to conduct surveys at 8-12 sites annually. Data from both programs are represented here. Types of corals observed included hard corals, soft corals, fleshy seaweeds and sponges. Surveys conducted at each site indicated a predominance of healthy corals with 40% to 60% live hard coral cover.

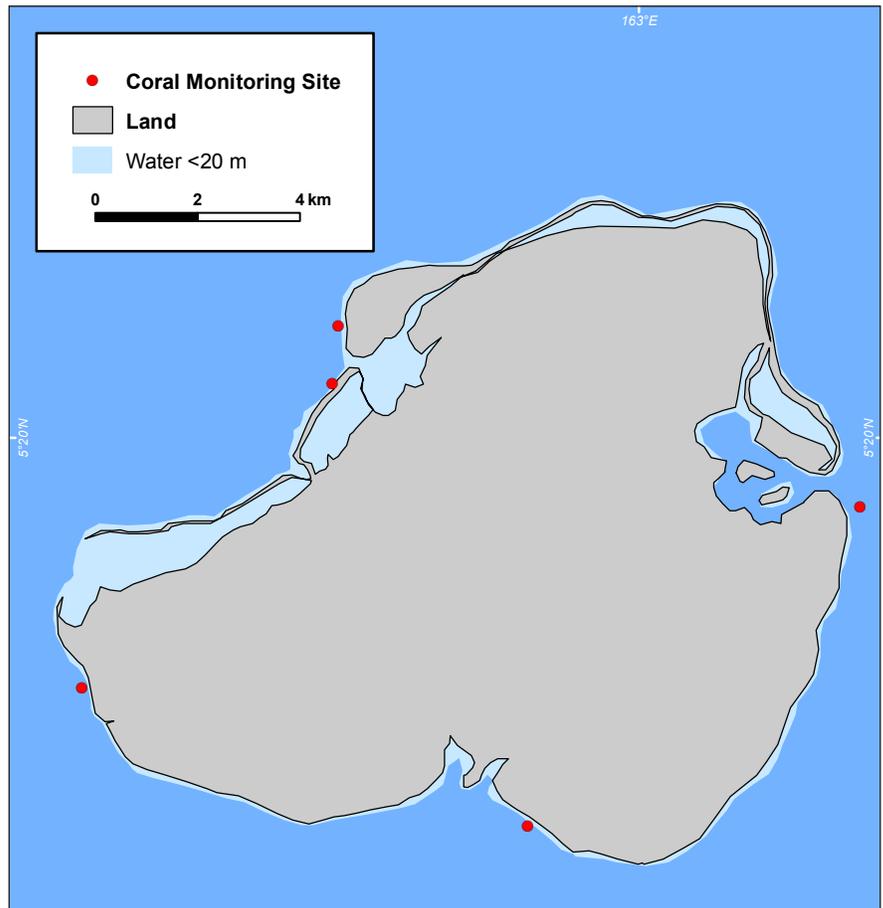


Figure 13.12. Location of monitoring sites in Kosrae. Map: K. Buja.

Surveys conducted at each coral monitoring site indicated that the status of coral reefs are in good condition, with percent cover of hard corals ranging from 64% at Inpeah, Molsron Malem; 60% at Inpucspucshah Utwe; 47% at Tukunsru Walung; 63% at Insrac Meloh Tafunsak; and 48% at Saclem Tafunsak or the Trochus Sanctuary. Other substrate components surveyed included coralline algae, dead coral, *Halimeda*, rubble, rock, sand, turf algae and others.

James Maragos, Terry Donaldson and staff from DMS and KCSO conducted REA surveys on coral and fish species in 2006 (Donaldson et al., 2007). The group split into two teams, with one focused on coral species and the other focused on fish species. Some of the common food fish recorded included blacktail snapper (*Lutjanus fulva*), blackspot emperor (*Lethrinus harak*), multibarred goatfish (*Parupeneus multifasciatus*), bullethead parrotfish (*Chlorurus sordidus*), swarthy parrotfish (*Scarus niger*), blue banded surgeonfish (*Acanthurus lineatus*) and whitecheek surgeonfish (*A. nigricans*).

The 2006 REA also indicated that some species of groupers, jacks, trevalleys, snappers, emperor, sweet lips and parrotfish were absent compared to survey conducted in 1986. There were also 59 new records of fish species seen throughout the survey that were not documented in 1986. There were a few humphead wrasse (*Cheilinus undulatus*) recorded, but no bumphead parrotfish (*Bolbometopon muricatum*). These two species of fish are considered to be very rare in Kosrae. There are approximately 500 species of fish found in Kosrae's reef, estuarine, mangrove and freshwater habitats and more than 71 species of mollusks are thought to be found in Kosrae. Out of 500 species of fish, 200 are commonly considered food fish (Figure 13.13).



Figure 13.13. A coral grouper swimming around a fringing reef in Kosrae. Photo: K. Adams.

Kosrae has recently limited the export of reef organisms except for personal and family use, such as shipping coolers of fish to relatives living abroad. The Kosrae Coastal Resources Inventory (KCRI) recorded 252 fish species in 1986. It also reported that more than 250 fish species are used as food fish in Kosrae (Environment Resources Section, 1989; KCRI; U.S Army Engineer District, Honolulu). The recent REA in Kosrae however estimated that there are 518 species of fish (Donaldson et al., 2007) and suggest that the total number of species occurring at Kosrae will increase with further sampling. The Kosrae REA report recommended consideration of future MPA designations in Kosrae and suggested several sites (29, 43, 36, 40 and 49) as possible choices for future MPAs.

### Pohnpei

Coral reef ecosystem monitoring in Pohnpei started in 2004. The monitoring program was recently expanded with monitoring of additional components to help coastal and marine resource managers better understand the condition of Pohnpei's coral reefs. The program currently monitors several ecosystem components: 1) grouper spawning aggregations; 2) MPA effectiveness; 3) changes in benthic communities over time; and 4) sedimentation. Methods for one through three are described in the 2005 edition of this report (Waddell, 2005). Results from these surveys are currently being analyzed.

To monitor sedimentation, the CSP, along with its partner agencies (Pohnpei State Department of Land and Natural Resources and Pohnpei State Department of Economic Affairs) are installing sediment monitoring traps adjacent to the start point of all 16 benthic monitoring sites, which use methods established by English et al. (1997). At each site, a total of three sets of sediment traps will be installed. Each set of traps will consist of three 5 cm x 11.5 cm sections of PVC pipe clustered around a central stake. Each set of traps will be anchored at a depth of 3 m below the mean low tide mark, at 1 m intervals adjacent to the start of the transect. Traps will be collected and emptied once every month during a 12 month study period. Sediment will be dried and weighed. Data collected from the sediment traps will be used to look for trends in seasonal and longer term changes in sediment load in the lagoon. Funding will be sought to continue sediment monitoring in subsequent years.

### Chuuk

The state of Chuuk is in the very early stages of establishing a long-term coral monitoring program. Ten Areas of Biodiversity Significance (ABS) comprising 20,683.29 ha in Chuuk have been identified by the FSM Blueprint (TNC, 2003), and these areas will be the basis for selecting the permanent monitoring sites. Any additional areas in need of monitoring and protection will be identified through a REA of Chuuk State and a biodiversity gap assessment for the FSM, both of which are planned for 2008.

The CCS will work with communities, Chuuk MRD, Chuuk EPA, the College of Micronesia-FSM (COM-FSM), TNC, PICRC and other partners on the proposed marine monitoring, and will also be responsible for writing and submitting the results of the project. The marine monitoring program will be established through the proposed monitoring of the three key biotic and abiotic categories of water quality, benthic habitat, and associated biological community structure that will include fish and macroinvertebrates (Figure 13.14).



Figure 13.14. Tridacna or giant clam encrusted with soft coral on the reef of Fannan Island, Chuuk. Photo: M. Gombos, PIMPAC.

Because CCS and its partners did not attend the first two coral reef monitoring workshops in July 2005 and July 2006 held at PICRC, they are in the very early stages of development of a marine monitoring strategy. However, key staff received on-site training in establishing sites and standard monitoring methodologies during the NOAA Coral Reef Monitoring Workshop held in Chuuk in July 2007. This work resulted in the identification of 10 potential monitoring sites that were chosen to contrast outer barrier reefs with reefs inside the lagoon and reef passes. Further training in monitoring for personnel is needed (R. Osiena, pers. comm.).

## Yap

As in most of the Pacific Islands, the rich and diverse ecosystems of Yap have historically been protected for subsistence purposes by traditional resource management practices. However, given the large-scale nature of modern day resource uses and other uncontrollable factors, traditional management practices are now facing challenges. Increasingly, marine ecosystem degradation is seen around areas of development in Yap (Goldman, 1994), and coral reefs are becoming sources of major economic benefit with conflicting uses in construction, export and tourism. According to an ecological baseline assessment prepared for the International Waters Project in Yap (PICRC, 2005), live coral cover ranged from 11–56% at five proposed MPA sites. Mean density of 14 target food fish species on transects at four proposed MPA sites ranged from 7 to 24 individuals per 100 m<sup>2</sup> (PICRC, 2005).

Reef areas in Yap are all privately owned in a strong and complex system of marine tenure (Smith, 1994). In order for present-day marine resources in Yap to be sustainably managed, scientific data must be collected and incorporated into traditional knowledge and management methods. Blending science and traditional management by using and building on local capabilities has been identified as the most realistic and successful method of conservation management in the region (Kelty and Kuartei, 2004; Starmer, 2003; Pinca, 2003; Kuartei and Matthews, 2003; Richmond et al., 2002). Similar programs have been implemented locally by other governments and cultures in the region (Starmer, 2003; Pinca, 2003; Kuartei and Matthews, 2003). The Environmental Stewardship Consortium (ESC) was formed in 2001 in response to a mandate from the Council of Pilung, Yap's council of chiefs and fourth branch of government. The mission of the ESC is to link science and traditional knowledge through a network of people representing government, traditional leaders and communities.

Establishing a locally-implemented, long-term marine monitoring program is listed among the top priorities for improving natural resource sustainability efforts in Yap State and the rest of the FSM (Yap Biodiversity Strategy and Action Plan, 2004; NBSAP, 2003; FSM Economic Summit, 2003). Leaders in the FSM have also identified the need for a full representation of the status of the FSM's marine ecosystems and an evaluation of their resiliency to stress to improve understanding of FSM's marine resources (FSM Economic Summit, 2003; NBSAP, 2003).

With funding from NOAA, YapCAP initiated a monitoring program in Yap State in collaboration with the Yap EPA and Yap MRD in the latter part of 2006. The overall long-term goal of the coral monitoring program in Yap is to characterize reef community development and assess the impacts that various stressors place upon Yap's reefs, and use this information to drive management. The objectives of the program are to:

- Establish simple, realistic monitoring methods;
- Collect and analyze a set of baseline monitoring data;
- Establish a Coral Reef Task Force network among local stakeholders in marine resource management in Yap; and
- Promote and begin to provide technical support for conservation efforts at the community level.

With assistance from PICRC, Yap's coral monitoring team, which is composed of supporting agency staff and designated local community representatives, began conducting marine surveys at six sites in December 2006 to collect baseline data on benthic cover, locally and commercially valuable macroinvertebrates and fish, and coral recruitment. The Yap monitoring team plans to conduct surveys annually at the six established sites using the standard methods presented at the monitoring workshops held by PICRC and NOAA in 2005 and 2006. The general public and communities involved in this marine monitoring program will be informed about results through presentations, information sheets and other educational materials. The results of the monitoring program will also be presented to the ESC and all its members.

In addition to the long-term monitoring program, a REA was recently conducted to fill gaps in information on the marine resources of Yap State. YapCAP, with support from Packard Foundation, NOAA and TNC, coordinated a multi-disciplinary team of scientists, monitoring staff and community representatives to conduct the REA from July 11-August 2, 2007. The team surveyed 19 sites around Wa'ab, 12 sites around Ngulu Atoll and 16 sites around Ulithi Atoll. Preliminary results were presented to the Chiefs of Ngulu and Falalop, one of the main islands of Ulithi Atoll, and to the ESC.

A preliminary list of 204 confirmed coral species was compiled, with 167 from Ngulu Atoll and 180 from Ulithi Atoll (Turak, in prep.). An estimated 215 coral species were recorded on Wa'ab (Houk and Starmer, 2007). Quantitative and qualitative benthic surveys were also conducted (Houk and Starmer, 2007). Researchers recorded a total of 625 species of fish for all three locations, including 349 new range records and 91 new records for Yap State (G. Allen, pers. comm.). The total known fish fauna of Yap State now stands at 787 species in 275 genera and 76 families. Additionally, predictions of the total number of reef fish based on the number of species in six key indicator families suggest that at least 928 species can be expected to occur at Yap and outlying atolls. The team found that surveyed reefs in general are in very good condition, especially at remote Ngulu Atoll (Figure 13.15).



Figure 13.15. A *Chlorurus microrhinos* in Ulithi Atoll of Yap (left). Photo: G. Allen. Ngulu Reef in Yap (right). Photo: P. Houk.

### Overall Condition and Summary of Analytical Results

The coral reefs around Kosrae are generally in good to excellent condition (Figure 13.16). However, monitoring throughout the years has indicated some potential stressors on the coral reef ecosystems. Since Kosrae is a very small island, there is still a pressing need to have further protection in order to decrease the impacts from coastal development and other activities that contribute to soil erosion and sedimentation.

Both local coral monitoring programs and coral reef research show that Pohnpei's coral reef ecosystems have been adversely affected by sediment runoff, dredging and predation by COTS. These three major forms of disturbance together have affected species composition and the structure of coral communities (Turak and DeVantier, 2005). Sediment runoff and dredging have



Figure 13.16. An anemone in Kosrae provides habitat for fish. Photo: K. Adams.

caused a major loss of coral cover and diversity at heavily-impacted sites, which are now covered by a layer of fine silt and have very low water clarity, hindering recovery. Results from monitoring showed little to no evidence of destructive fishing, impacts from boat anchoring or damage from SCUBA diving. Abundance of targeted species of reef fishes, particularly in the families Lethrinidae, Lutjanidae and Serranidae, appeared to be low in many areas, possibly indicating local overfishing. The lack of predators combined with nutrient enrichment from runoff in the lagoon may also be contributing to the prevalence of the COTS.

Coral reefs in Yap are in relatively good condition with diversity being among the highest in the FSM (Allen, 2007; Hasurmai et al., 2005; Kelty and Kuartei, 2004; Richmond et al., 2002). However, during recent REA surveys, there were signs of coral bleaching, COTS damage, destructive fishing from foreign poachers, and physical damage from possible storms or ship groundings. The highly threatened Napoleon wrasse (*Cheilinus undulatus*) was relatively abundant (observed at 50% of the survey sites), but with an estimated average total length for observed individuals of only 48 cm (Allen, 2007). In addition, fewer sharks than expected were seen at Ngulu Atoll, despite good reef conditions, which may indicate the presence of foreign fishers engaged in illegal shark-finning operations (Allen, 2007).

## CURRENT CONSERVATION MANAGEMENT ACTIVITIES

In 2003, the FSM completed a National Biodiversity Strategy and Action Plan (NBSAP) with the goal of protecting and sustainably managing a full representation of the country's marine, freshwater and terrestrial ecosystems. In 2003, the government of the FSM, the U.S. Forest Service, TNC, university scientists, and local experts also drafted *A Blueprint For Conserving the Biodiversity of the Federated States of Micronesia* (the FSM blueprint) in order to begin to address this goal. A total of 130 ABS including 86 coastal and marine sites comprising 260,948 ha (over 1,007 square miles) were identified nationwide (Table 13.2).

Each of the four states of the FSM is in various stages of developing protected areas networks. Pohnpei is the furthest along with 11 legal marine sanctuaries and a central Watershed Forest Reserve. Historically, there has been little national involvement in protected area establishment and management. However, the establishment of a Protected Areas Network is a high priority under the NBSAP. The NBSAP sets a clear conservation objective under the major theme of ecosystem management:

*"A full representation of the FSM's marine, freshwater, and terrestrial ecosystems are protected, conserved and sustainably managed, including selected areas designated for total protection."*

In December 2004, a broad range of FSM partners signed the National Implementation Support Partnership (NISP) Agreement, a Memorandum of Understanding (MOU) that covers the implementation of the Convention on Biological Diversity's Programme of Work on Protected Areas. The MOU provides an overarching framework for establishing the proposed nation-wide network of protected areas. The project partners include the national government, the four state governments, the COM-FSM, Micronesia Conservation Trust (MCT), FSM Visitors Bureau, TNC, CSP, KCSO and YapCAP.

Over the past several years, Kosrae has started to develop a MPA program that involves co-management of coastal resources between local communities and state resource management agencies. Currently, Kosrae has five conservation areas that are managed by government agencies and/or local communities. These are: the Utwe-Walung Marine Park, Utwe Biosphere Reserve, the Awane Marine Park

Table 13.2. Number and size of ABS by type. Source: TNC, 2003.

ABS SITE TYPE	NUMBER OF ABS SITES	AREA (ha)	AREA (mi <sup>2</sup> )
<b>TERRESTRIAL SITES</b>			
Yap	3	651.94	2.52
Chuuk	9	4,328.06	16.71
Pohnpei	9	12,833.28	49.53
Kosrae	2	4,835.04	18.66
Total Terrestrial	23	22,648.32	87.42
<b>MARINE ONLY SITES</b>			
Yap	6	49,471.10	190.95
Chuuk	10	20,683.29	79.83
Pohnpei	5	12,480.50	48.17
Kosrae	1	54.52	0.21
Total Marine	22	82,689.39	319.17
<b>COASTAL MARINE SITES</b>			
Yap	21	24,007.43	92.66
Chuuk	20	77,089.91	297.55
Pohnpei	18	75,695.26	292.17
Kosrae	5	1,466.07	5.66
Total Coastal Marine	64	178,258.67	688.04
<b>COASTAL FRESHWATER SITES</b>			
Yap	2	31.76	0.12
Chuuk	11	936.66	3.62
Pohnpei	3	5,283.09	20.39
Kosrae	4	1,904.89	7.35
Total Coastal Freshwater	20	8,156.39	31.48
<b>Overall Total</b>	<b>130</b>	<b>291,752.77</b>	<b>1,126.11</b>

and Areas of Special Concern, such as the Trochus Sanctuary and the Okat-Yela Mangrove Reserve. After completing the community consultation for planning and establishment of Utwe Biosphere Reserve, KCSO also launched a community consultation with the community of Tafunsak for planning and establishing a marine protected area there. There is also a proposed marine park in Malem. The Utwe Biosphere Reserve is a community-based project established in 2002 and is the FSM's first biosphere reserve. Utwe Biosphere Reserve is located within the Utwe-Walung Marine Park. The Utwe Biosphere Reserve was created to protect and conserve the resources within the area and to provide opportunities for public education and scientific research. The Utwe-Walung Marine Park was created in 1996 to protect extensive mangrove and coral reef ecosystems along the undeveloped southern shore of Kosrae. The Marine Park is also a community-based project managed by a board of directors, a park manager, and landowners, with assistance from conservation agencies and organizations in Kosrae. The Marine Resources Act of 2000 (Kosrae State Code, Title 19) is enforced by the DMS, public safety department and the Kosrae Island Resource Management Authority as the Kosrae State government regulatory agency. Environmental awareness activities have been carried out within the community and the schools to help support and strengthen the conservation effort in Kosrae. KCSO also developed and implemented an environmental awareness program entitled the *Friday Radio Spots*. This program airs important information about different ecosystems, the threats they face, and the solutions to reverse negative impacts. Kosrae also has an extensive system of 54 mooring buoys around the island designed to minimize anchor damage to corals at popular dive sites.

Chuuk communities have begun conservation work in several ABS, including the Parem Totiw Marine Area ABS, the Wichap-Epinup-Peidiu-Nukanap Mangrove and Marine area ABS and the Polle Piannu Pass Grouper spawning area ABS. These ABS sites are at different stages in management planning, but all need reliable scientific monitoring data to help determine the status of the resources and the effectiveness of current management activities. The data gathered will be disseminated to communities through awareness programs and school presentations to promote interest in MPA management, specifically for coral reefs, and the expansion of the MPA network.

Because life in Chuuk remains very traditional, several chiefs have implemented protective measures for specific conservation purposes, such as the protection of a turtle nesting site at Nomun Weito and implementation of a no-take area in the Halls region (R. Oseina, pers. comm.). The effectiveness of traditional management strategies in Chuuk encourages other communities to adopt such measures.

In Yap State, there is currently one MPA set up on Wa'ab, a Locally Managed Marine Area (LMMA) with 25.9 ha (0.1 mi<sup>2</sup>) of reef set aside by Riken community. In addition, YapCAP is working with the communities of Qokaaw and Kadaay on the Nimpal Channel LMMA and Maaq and Lebinaw on the Peelaek Channel LMMA.

At the Eighth Conference of the Parties to the Convention on Biological Diversity held in March 2006 in Curitiba, Brazil, TNC co-hosted a high-level event where the leaders of the five political entities of Micronesia (Republic of Palau, Federated States of Micronesia, Republic of the Marshall Islands, Commonwealth of the Northern Mariana Islands and Guam) announced the Micronesia Challenge to the international community.

The program challenges Chief Executives of Micronesia to:

- Sustain unique island biodiversity;
- Ensure a healthy future for island people;
- Protect unique island cultures;
- Guard pristine island environments, the foundations of their future development
- Sustain the livelihoods of island communities;
- Contribute to global and national targets set out in the Millennium Development Goals, the Johannesburg Plan of Implementation for the World Summit on Sustainable Development, the Mauritius Strategy for Small Island Developing States, the U.S. Coral Reef Task Force National Plan of Action and the relevant Programmes of Work of the Convention on Biological Diversity; and
- Agree to undertake an expanded commitment to preserve marine and terrestrial environments by “... *Effectively conserving at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020.*”

The signatories to the FSM NISP have fully embraced the Micronesia Challenge as a means to leverage financial, technical and community support for the establishment of the FSM Protected Areas Network (PAN). In early 2006 a core team, comprised of key FSM government and regional NGO members, was formed to guide establishment of the FSM PAN. The NISP signatories and core team, in particular the local conservation NGOs, have taken the lead on engaging members of the community to garner support for the FSM PAN and the Micronesia Challenge, resulting in a range of actions such as a legislative resolution in Kosrae and calls for traditional protected areas in Yap. From, January 2005 to March 2007, core team members conducted a total of 13 state visits to provide marine technical assistance, introduce the concept of the PAN and the Micronesia Challenge and promote participation. In October 2006, the first FSM Environment Conference was held in Pohnpei and included sessions on the PAN and Micronesia Challenge. A large delegation from the FSM, including representatives from all four states and the national government attended the first regional Micronesia Challenge action planning meeting in Palau in December 2006. Through the Micronesians in Island Conservation Network and state site visits, TNC continues to assist local partners in their efforts to build consensus for the network from the bottom up, beginning with communities.

In addition, NGOs and government agency partners have helped communities with existing protected areas to do site-based planning activities. Conservation Action Plans have been developed for four high priority sites that will be part of the protected areas system: Kosrae Yela Terminalia Forest, Pohnpei Watershed Forest Reserve, Pohnpei Lagoon and Kosrae Utwe-Walung Biosphere Reserve.

In 2006 MCT began co-coordinating the Pacific Islands MPA Community (PIMPAC). PIMPAC is a NOAA-funded initiative to support MPA development and management work. Thus far PIMPAC has provided capacity building support to MPA managers and organizations throughout the FSM and Micronesia. This support includes trainings on developing MPA management plans, project design, fundraising, grants and report writing and learning exchanges. PIMPAC conducted a management planning workshop in October 2006 (Figure 13.17). Sixteen FSM resource managers and conservation practitioners who are involved in MPA management participated (Figure 13.18). These managers are actively working on management plans for pilot sites in their islands. The PIMPAC resource team has been providing follow-up specific to each state's needs.



Figure 13.17. Julita Albert of Chuuk EPA noting UFO, Fefan MPA Goal at Pacific Islands MPA Community Regional MPA Management Planning Workshop in Chuuk, October 2006. Photo: D. Wusinich-Mendez, PIMPAC.



Figure 13.18. The Pohnpei group pictured deep in discussion (left). Participants from 'UFO', which stands for the island of Fefan's three villages of Unuuno, Fongen, Onongoch, working together to identify management priorities (right) at the PIMPAC MPA management planning workshop in Chuuk, October 2006. Photos: M. Gombos, PIMPAC.

Finally, in order to address critical capacity needs in the FSM and the rest of the region, an internship program was established with support from the Pew Fellowship in Marine Conservation, NOAA and TNC in 2006. Conservation "champions" in each of the five island jurisdictions are assisting with outreach and education aspects of the Micronesia Challenge. These champions will be housed in a focal point organization or agency within each island jurisdiction. Champions will be mentored by Willy Kostka, a 2006 Pew Fellow for Marine Conservation and the executive director of MCT, PAN Coordinators from the FSM, Palau and the Marshall Islands, TNC staff, and senior staff from each focal point agency. The mentors will assist the champions in developing and implementing Micronesia Challenge outreach campaigns and professional development plans.

### And Atoll Declared A Biosphere Reserve

In 2007, the And Atoll Biosphere Reserve was established as the first United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserve in the state of Pohnpei (Figure 13.19). It is also Pohnpei's first government and private landowner co-managed MPA. Sanctioned by the Bureau of the International Coordinating Council of UNESCO's Man and the Biosphere Program, Biosphere Reserves are areas set aside to illustrate proven conservation methods designed to sustain the area's ecosystems. In September 2007, UNESCO added 23 new reserves sites in 18 countries to its global network of more than 500 reserves.

In 2002, the Conservation Society of Pohnpei and UNESCO's Pacific office began working together to establish And Atoll as a biosphere reserve. In the process of petitioning for Biosphere Reserve status, it was determined that more fieldwork, assessment and discussion were required to gain the information needed to complete the application for submission. A REA was conducted in July 2006, which revealed And Atoll is one of the most biologically significant areas in Pohnpei State.

Due to its isolation and lack of human occupation for more than 20 years, And Atoll had already been established as Pohnpei's number one marine Area of Biodiversity Significance and a Priority Action Area (Figure 13.20). And Atoll retains one of the last relatively intact seabird rookeries in the region and provides crucial nesting grounds for rare sea turtles. The atoll's main channel has also been identified as one of the few grouper spawning and aggregation sites on Pohnpei. And Atoll is also home to the healthiest giant clam population in the state, and attracts aggregations of sharks, barracudas and other marine life.

Over-fishing, bird and turtle hunting and egg collection have become major threats to And Atoll. Achieving the status of biosphere reserve is an important initial step to protect and conserve these resources. Biosphere reserves include three zones: 1) core zones: commonly known as "no-take" areas; 2) buffer zones: allow certain, restrictive activities; and 3) transition zones: where human settlements are located and most activities such

as agriculture, fishing, logging and mining are allowed. The core zones of And Atoll Biosphere Reserve serve as models for Pohnpei's existing MPAs, where fishing and/or taking of marine life is not allowed.



Figure 13.19. Aerial view of a reef pass at And Atoll. Photo: J. O'Hare.

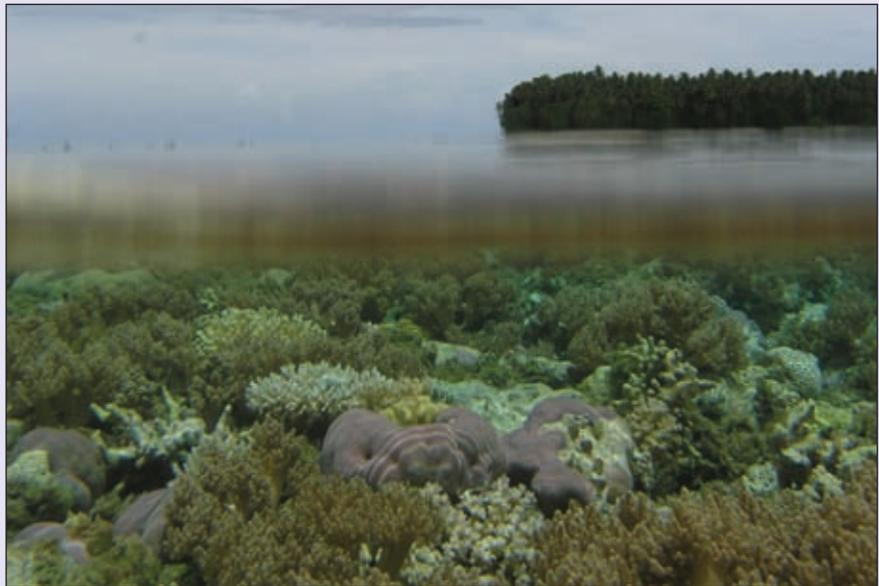


Figure 13.20. And Atoll in Pohnpei was declared a UNESCO Biosphere Reserve in 2007. Photo: E. Joseph.

## OVERALL CONCLUSIONS AND RECOMMENDATIONS

The FSM depends heavily on coral reefs for food and revenue derived from fish sales to local markets, diving and other tourism activities in marine areas (Figure 13.21). But there are many challenges facing FSM reefs ranging from local threats, such as over-harvest of fishery resources and impacts from land-based activities, to global threats associated with climate change, warming temperatures and ocean acidification. The country has been experiencing the erosion of traditional management systems as well. These threats have led to a general decline in the condition of coral reef resources, especially near population centers.

However, in the past 10 years, the FSM has made significant commitments at many levels to try and reverse this trend. Communities have sought assistance from local conservation NGOs and government agencies to blend traditional management practices, science, and new technologies to begin the process of building an ecologically-connected,

resilient system of protected areas from the bottom up. High level leadership and political will, illustrated by such commitments as those made under the Convention on Biological Diversity and the Micronesia Challenge, have supported these grass roots efforts at the state level. Regional support from agencies and organizations including NOAA, the Department of the Interior's Office of Insular Affairs, SPREP, TNC, LMMA, Conservation International and MCT continue to provide technical and financial assistance for local implementation efforts.

Unfortunately, for a country encompassing an estimated 14,517 km<sup>2</sup> of coral reefs (Rohmann et al., 2005), additional funds for conservation efforts, including monitoring, are critically needed. In the latter part of 2006, the FSM began a process, with assistance from MCT and TNC, to develop a sustainable financing plan for establishing, implementing, maintaining and monitoring a Protected Areas Network and to achieve the goals of the Micronesia Challenge. Preliminary costs and revenues for effectively managing at least 30% of nearshore marine resources and at least 20% terrestrial resources in a nation-wide protected areas network have been identified by each state and final total costs and revenues are currently being calculated. Once these are determined, strategies to fill the gaps will be developed and implemented.

A recently completed threats and needs assessment (Kostka and Gavitt, 2006) included a number of recommendations to address some of these problems. In March 2007, MCT signed a two year contract with Timothy Fenlon and Donna Wrembeck to carry out these recommendations. The team will carry out the following in all four FSM states:

- Develop a MOU between Public Safety and agencies involved in managing natural resources for each state;
- Conduct a review of the current state and (if applicable) national statutory provisions and enforcement policies;
- Undertake enforcement assessments;
- Develop and deliver appropriate training on development;
- Develop a monitoring and evaluation format.

The project is progressing very well and has begun to yield tangible outcomes, including MOUs signed between relevant stakeholders to jointly carry out resource management activities.

Although the FSM has made a great deal of progress toward effective management and monitoring of their vast coral reef resources in the past few years, many challenges still remain. Additional priorities to continue to strengthen management and protection of coastal marine resources in the FSM include establishing new community-based MPAs for critical reef habitat, completing a REA for Chuuk and a gap assessment for ABS of the FSM, completing a capacity needs assessment for the PAN, and determining baselines and developing indicators for measuring management effectiveness toward achieving the goals of the Micronesia Challenge.



Figure 13.21. This school of rainbow runners in Pohnpei is a valuable marine resource for both dive tourism and fisheries. Photo: E. Turak.

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