Federated States of MICRONESIA

Fourth National Report

2010

Implementation of Article 6 of the Convention on Biological Diversity

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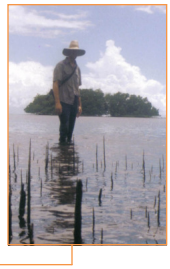

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Dedication

This report is dedicated to Sofia Elizabeth Raine Wortel and Kloie Juliana Sunshine Wortel, the future generation of environmental champions.

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Preface

This is the Federated States of Micronesia Fourth National Report on the Convention on Biological Diversity. The report focuses on the impact of the National Biodiversity Strategy and Action Plan on national development prerogatives, particularly in relation to the minimization and/or reversal of the rate of biodiversity loss, which is the primary goal of the Convention on Biological Diversity; otherwise known as the 2010 Target. This report does not delve into each of the four State Biodiversity Strategy Action Plans – of which there are four – as these are the localized action plans which were developed out of the NBSAP, and are therefore considered part and parcel of the national aims. The need for biodiversity considerations into overall development processes is more or less widely recognized in FSM, and the Government has prepared a Strategic Development Plan (2003) that integrates an overarching Environmental Policy Strategy through the year 2023.

The report was prepared under a grant provided by the United Nations Support to GEF Eligible CBD Parties (GFL/2328-2716-4A82): "Carrying out 2010 Biodiversity Targets National Assessments – Phase III." The lead author of the report was Olivier Laurens Wortel, National Consultant for the FSM CBD 4th National Report. Members of the National Coordination Team were: Marion Henry, Acting Secretary of the FSM Department of Resources and Development; Alissa Takesy, FSM Protected Area Network Coordinator; Willy Kostka, Executive Director of the Micronesia Conservation Trust; Mary Rose Nakayama, Project Manager for the FSM Conservation and Environmental Protection Programme; Joe Konno, 2nd National Communication (on Climate Change) Coordinator; Phillip Joseph, Assistant Secretary for Infrastructure; Roseo Marquez, National Integrated Water Resource Manager; Bill Raynor, Asia-Pacific CR Regional Marine Program Director for The Nature Conservancy; Cindy Ehmes, Sustainable Development Unit, Office of Environment and Emergency Management; Ricky Carl, Deputy Director for External Affairs, The Nature Conservancy Micronesia Program; Okean Ehmes, UN Joint Presence in Micronesia Director; and Lucille Apis Overhoff, Micronesia Small Grants Programme Coordinator.

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Abbreviations

ABS	Areas of Biodiversity Significance
ADB	Asian Development Bank
BSAP	State Biodiversity Strategy and Action Plan
CA	Conservation Area
CBD	Convention on Biological Diversity
CBSAP	Chuuk Biodiversity Strategy and Action Plan
CCNC	Climate Change National Communication
CEPP	Conservation and Environment Protection Program
CNMI	Commonwealth of the Northern Mariana Islands
COM-FSM	College of Micronesia – National Campus
COP	Convention of the Parties
CSP	Conservation Society of Pohnpei
CWC	Chuuk Women's Council
DEA	Department of Economic Affairs
DSAP	Development of Sustainable Agriculture in the Pacific
EDF	European Development Fund
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EU	European Union
FAA	Federal Aviation Administration
FSM	Federated States of Micronesia
FSM SDP	National Strategic Development Plan
GEF	Global Environment Facility
GES	Green Energy Solutions
IDP	Infrastructure Development Plan
IFCP	Island Food Community of Pohnpei
IST	Invasive Species Taskforce
JEMCO	Joint Economic Management Committee
KCSO	Kosrae Conservation and Safety Organization
KBSAP	Kosrae Biodiversity Strategy and Action Plan
KIRMA	Kosrae Island Resource Management Authority
KWA	Kosrae Women's Association
LMMA	Locally Managed Marine Areas
MCT	Micronesia Conservation Trust

Abbreviations (continued)

MERIP	Marine Environmental Research Institute of Pohnpei
MIC	Micronesians in Island Conservation
MicSem	Micronesia Seminar
MMMR	Micronesia Management and Marketing Resources
MPA	Pohnpei Biodiversity Strategy and Action Plan
MSGP	Micronesia Small Grants Programme
NARSD	National Assessment on Sustainable Development
NBSAP	National Biodiversity Strategy and Action Plan
NCT	National Coordination Team
NEMS	National Environmental Management Strategies
NGO	Non-Government Organization
NOAA	National Oceanic and Atmospheric Administration
NSA	Non State Actor
NYBG	New York Botanical Gardens
ODA	Oversees Development Assistance
OEEM	Office of Environment and Emergency Management
PAA	Priority Action Area
PAN	FSM Protected Areas Network
PBSAP	Pohnpei Biodiversity Strategy and Action Plan
PIMPAC	Pacific Islands MPA Community
PWMS	Pohnpei Waste Management Services
REA	Rapid Ecological Assessment
SAP	Strategic Action Plan
SDP	National Strategic Development Plan
SD Council	National Environmental Management and Sustainable Development Council
SPC	Secretariat of the Pacific Community
SPREP	South Pacific Regional Environmental Programme
TNC	The Nature Conservancy
UNDP	United Nations Development Program
WCPFC	Western and Central Pacific Fisheries Commission
WWA	Wichap Women's Association
YapCAP	Yap Community Action Program
YBSAP	Yap Biodiversity Strategy and Action Plan
YELA	Yela Environment Landowners Authority
YINS	Yap Institute of Natural Science

Fourth Country Report from the Federated States of Micronesia to the United Nations Convention on Biological Diversity

Executive Summary

Key Findings of the FSM 4th National Report

"With the increasing rate of global change, the biodiversity of islands represents some of the most vulnerable resources on the planet. This makes islands' conservation efforts especially important. Islands are sentinels of what is to come, as what happens to islands will eventually befall the rest of the world. To stand up among the nations of the world, a country must have something of value. The FSM has something of value in its healthy reefs and island ecosystems, their biodiversity, and a heritage of living with these resources. Our efforts to care for this biodiversity could help guide the way to a sustainable future and become our role in the global community and our gift to the world."

---A quote from Dr. Margie Falanruw, who resides in Yap State, FSM, taken from a section of her 2002 report, *Terrestrial Biodiversity of the FSM*, entitled, 'Why should we be interested in biodiversity?'

Executive Summary

1 Introduction

The Federated States of Micronesia (FSM) is at a critical juncture. The Constitution of the FSM – ratified in 1978 at the dawn of the federation's young nationhood – states: "*We affirm our common wish to live together in peace and harmony, to preserve the heritage of the past, and to protect the promise of the future...to become the proud guardian of own islands, now and forever.*" Preserving the heritage of the past and protecting the promise of the future is a reference to the biological wealth of the FSM and its continued viability contingent upon long-term stewardship. Sixteen years after becoming an independent nation on the world stage the FSM ratified the Convention on Biological Diversity (CBD) in 1994. Seven years thereafter, in 2001, the National Biodiversity Strategy and Action Plan (NBSAP) was developed as a national strategy that illuminates the nation's Constitutional prerogative with specific goals, objectives and actions that seek to not only maintain the deeply rooted environmental morals of the traditional lifestyle of the FSM, but to also achieve the international standards of the CBD. A mere five years later, in 2006, the FSM, along with the Republic of Palau and the Republic of the Marshall Islands (RMI), it's autonomous sister island neighbors in the North Pacific to the east and to the west, along with the Commonwealth of the Northern Mariana Islands (CNMI) and Guam, brought the Micronesian Ethic to the world in the seminal announcement of the Micronesia Challenge at the 8th Convention of the Parties in Curitiba, Brazil.

This notwithstanding, the people living on the islands of the FSM continue to strive toward an expanded and increasingly pervasive capitalistic lifestyle, influenced largely by the free market values of the United States government. Moving away from a sharing, familial country to one more and more based upon individual gain and need has resulted in a widening division of wealth, which in turn – combined with the ripple effects of the global economic downturn – has led to exacerbated pressures on local ecosystems for survival in a capitalized economy. Reefs and forests are not only essential to communal and rural survival – more than 80% of the FSM population lives in rural areas – they are also the linchpin of economic development. Terrestrial ecosystems produce the largest local inputs to the macro-economic fabric of society in the form of betelnut, sakau, citrus and various staple root crops. Marine ecosystems are even more vital: nearshore and offshore fisheries bring in tens of millions of dollars annually to the functioning micro and macro-economic frameworks. The primary source of local revenue at the national level remains through the sale of tuna fishing licenses and the foreign fleets in FSM waters are growing per the pecuniary prerogatives of a developing nation. Ecological pressures therefore are on the upswing.

A clear aim of both the NBSAP and of the CBD (and the primary preoragatve of the conservatoin NGOs in the Micronesian subregion) is to utilize an integrated ecosystem approach through both customary and modern means that maintains ecosystem and species integrity for the benefit of people (i.e., sustainable use as a way to preserve local lifestyles and diets and to reduce the mounting hardship faced by an increasing percentage of the populace.)

In concert, the unique and fragile ecosystems and the plethora of species that the 12 principle biomes of the FSM harbor and generate, have by all relevant international conservation measures produced one of the world's singular biodiversity hotspots. The extensive reef and forest biomes of the FSM also provide a major sink capacity for the world's total human-sourced greenhouse gas emissions of carbon dioxide, methane, nitrous oxide and other greenhouse gases (FSM CCNC, 1997), while at the same time are under severe and mounting global climate change pressures. Monumental and significant environmental protection efforts abound. Indeed, the culture carries forward a measured respect for nature in its daily lifestyle. Thus both the development and the conservation arenas provide the juxtaposition that ultimately measures the historical crux at which this nation finds itself, and leads to the discussion and interplay on sustainable development, and if such a neat phrasing can indeed be achieved in reality. It is within this development and historical context that this rather unique and extremely fragile biodiversity – which of course includes the human inhabitants and their cultures – that struggles to thrive alongside an increasingly globalized sphere of influence on this part of the world.

This is but one example that highlights the broader challenges that the nation faces today. The FSM of course has a strong environmental ethic that runs through its history anyway, and exists to some degree today, but it has become more fragmented under the pressure of a type of development that is often blind to the common ecological sensibility of the past. The instruments, machinery, speed and resources dedicated to development are still much greater than those applied to maintaining the ecological status quo. The Convention is therefore an excellent framework, a tool perhaps, by which to ensure some balance does exist in the pursuit of progress.

The implementation of the Convention on Biological Diversity through the NBSAP has been a major catalyst to the conservation of biodiversity in the FSM. In a place where people live amidst and have relied directly upon the climax function of ecosystems for survival for many generations, it can be said that the Convention is a modern means by which to put back into equilibrium a society that is becoming daily removed from a traditional way of life. Modernity is to be expected of course, and perhaps even encouraged in essential matters of society; the ecology of place should be equally expected, and respected as a prominent partner at the table of progress.

II Overview of biodiversity status, trends and threats

The Federated States Micronesia, as a biome, houses some of the most superlative biodiversity on the face of the earth. Stretching from the middle of the Pacific to Southeast Asia and eclipsing the size of Western Europe, the FSM as part of the Micronesian sub-region is one of the preeminent global biodiversity hotspots strattling the equator. These oceanic islands of the FSM, in the Caroline Islands, thus harbor some of the most biologically diverse forests and coral reefs in the world (TNC 2003). Over 1,239 species of ferns and flowering plants have been described in the FSM. Approximately 782 species are native, including about 145 species of ferns, 267 species of monocots and 370 species of dicots (Fosberg et al 1987, Falanruw 2002). More than 200 of these plants are found nowhere else on earth (NBSAP 2002), with additional estimates that nearly 80% of the plant life in the FSM is likley to be endemic.

The Federated States Micronesia, as a biome, houses some of the most superlative biodiversity on the face of the earth. Stretching from the middle of the Pacific to Southeast Asia and eclipsing the size of Western Europe, the FSM as part of the Micronesian sub-region is one of the preeminent global biodiversity hotspots strattling the equator. These oceanic islands of the FSM, in the Caroline Islands, thus harbor some of the most biologically diverse forests and coral reefs in the world.

Its terrestrial ecosystems also harbor unique avian, mammilian, reptilian and other species, including owls, flying foxes, parrots, giant geckos, skinks, dragonflies and snails: over 27 species of reptiles and amphibians, most of them native and at least 4 endemic (WWF 2009); five endemic species and subspecies of fruit bats of the genus *Pteropus* and a sheath-tailed bat of the genus *Emballonura;* and, 119 species of birds, including 31 resident seabirds, 33 migratory shorebirds, 19 migratory land or wetland birds and 5 vagrant species (Engbring et al.1990). When one considers the land area constituting the FSM's 607 islands is only 4,840 square km (FSM CCD 2006), it makes the compact and thriving biodiversity on this group of centrally positioned islands within the greater Micronesian sub-region as unique and spectacular as they are fragile and threatened.

Its coastline is about 3,300 nautical miles (FSM NARSD 2006). Its reefs, estimated at 14,517 km2, providing coastal protection and the source of livelihood for a majority of FSM citizens, are home to more than 1,000 species of fish, more than 350 species of hard coral (NBSAP 2002, FSM NARSD 2006), and 1,200 species of mollusks (FSM PNRCCD). Beyond, the marine area within the FSM's Exclusive Economic Zone (EEZ) totals over one million square miles (almost 3 million square kilometers) and includes a multitude of abundant and varied life and natural resources (UNCCD 2002). Of the hundreds of islands within this vast seascape, a number of the larger islands, which represent a minority, are relatively large and mountainous, while the majority are small, flat coral atolls or raised coralline islands, which have little or no human inhabitants but instead serve as hubs of habitat and regeneration for a mutitude of species, including sea turtles, sea birds, sharks, crabs, clams, rays, fish and many other species that are able to thrive in the tropical equatorial life belt of the world. Indeed, this massive area nearly the size of the continental United States is spawning gound and

habitat for much of the worlds' healthy remaining reef, marine and paelegic fish populations that are also increasingly exposed to the food needs of a rapidly enlarging global human population.

It is thus that the terrestrial and marine ecosystems within this massive biome of sea and land largely provide the basic needs of the inhabitants that have relied upon and continue to rely upon the fringing and barrier reefs, the blue holes, the coral gardens, the reef flats and sea grass beds, the beaches, the estuaries, lagoons and bays, the mangrove swamps and forests, the fresh water swamps and forests, the rivers and aquifers and the mountain and cloud forests for nearly every need imaginable. Indeed, the biodiversity and natural heritage of the FSM are both globally significant *and* the foundation for the country's long-term economic self-sufficiency. Maintaining the habitats and ecosystems that nurture this diversity is crucial for improving the people's quality of life and sustaining the country's rich traditions (FSM NARSD 2006).

Status

The status of FSM biodiversity is both spectacular and extremely fragile. It is influenced by both natural and anthropogenic features, and has a multitude of unique and biologically notable terrestrial, coastal and marine, inland wetland, riparian and agricultural ecosystems. Forests are a predominant vegetation type on the islands, and contain a wide variety of species. They range from lowland, premontane and montane rain forests, moist evergreen forests, to dwarf or cloud forests of the tropical moist forest ecoregion, and the predominant dry mixed broadleaf forests, mangrove forests and savannas of the tropical dry forest ecoregion.

TABLE 1: Land Balance Sheet for FSM (high islands only)

Type of land	Hectares (ha)
Reserved land (reservoirs, streams, roads etc.)	1,305
Mangroves and Marsh	9,112
Swamp forests	1,014
Upland forests	20,871
Palm forests	1,383
Agroforests	19,366
Secondary vegetation	4,020
Grasslands	3,825
Total land area	**70,896**

Source: adapted from Whitesell et al. 1986, MacLean et al. 1987, and Falanruw et al. 1987a&b)

Not surprisingly, a high ecosystem diversity in the islands of FSM has also given rise to a wide range of indigenous species among which are many climatic and edaphic variants, particularly among the plants (Glassman 1952, Fosberg et al. 1987, Falanruw 2002, Balick 2009), indicating the existence of a relatively high genetic diversity. Furthermore, the various geo-evolutionary and geological processes in FSM, coupled with large spatial variations in climate and topography, have promoted isolation of species resulting in a large

number of geographically relict species not found anywhere else in the world (TNC 2003, Balick 2009). In general, the mountain, riparian, coastal and reef ecosystems harbor a wonderful and useful mix of species, nearly all essential to the daily lives of the people, most particularly those in the more isolated and rural areas, which are the majority (FSM 2000c). These include the forest pigeons and fruit bats, the river eels, freshwater prawns and river snails, rabbit, mullet and trevally fish, and the coral groupers, sea turtles and reef sharks that inhabit them.

Trends

Yet it is this very geographic isolation, precise ecological uniqueness, and species richness and abundance that also provides for an overall trend of extreme fragility and of the potential continuing loss of biodiversity, particulary amongst the indiginous ecosystems and species of the FSM. Thus the increasing trend for the loss of populations of species due to habitat loss, degradation and fragmentation, is expected to have adverse effects on the genetic diversity of populations--among both the fauna and flora—in the long-term (CCNC, 1997). In order to highlight the overall trends for biodiversity in the FSM, let's look at one representative example that carries a very high biological, cultural and economic value to the nation: near shore fisheries as part of coastal and marine ecosystems. One of the most common refrains in the FSM – as common as the white sand beaches, the prolific rain forests and the crystal blue reefs – is that there are not nearly as many fish as there used to be; it's just not as good as it was in the old days *when*…Such anecdotal tales surely have merit; even in the last ten years, certain areas of reef in the FSM that are being fished show a decline in species diversity as well as number. Rapid Ecological Assessments and Fish Market Surveys carried out throughout the FSM between 2005 and 2007 support such sentiment: current harvest practices and amounts simply do not provide a picture of sustainability. The reefs and associated nearshore ecosystems – seagrass beds, mangroves, brackish channels and lakes – are the collective bread basket of the FSM. These systems litterally produce tens of millions of pounds of commercially and culturally important food, which is the foundation of the healthy, local diet. A study conducted in 2006 over a four-month period in a representative rural community in FSM revealed that it consumed 127 different species of fish over that time span.

TABLE 16: Landings for coastal, offshore and subsistence fisheries in FSM (tonnes)

Island of port	Offshore locally–based	Coastal commercial	Subsistence	Total
Kolonia, Pohnpei	2,000	1,700	650	**4,350**
Weno, Chuuk	250	2,000	500	**2,750**
Colonia, Yap	200	800	500	**1,500**
Lelu, Kosrae	50	200	250	**500**
Other	0	300	3,100	**3,400**
Total:	**2,500**	**5,000**	**5,000**	**12,500**

Source: SPC, 2002

Some semblance of balance must be restored if biodiversity levels are to be maintained, let alone reversed. The Convention has thus been in play at the appropriate time, not coincidentally, guiding policy makers, NGOs and communities in working toward sustainability. Indeed, the FSM has made an ambitious commitment through the Micronesia Challenge – with the NGOs at the lead with the governments of the region – and community participation and buy-in is still essential moving forward if these aims are to be effectively achieved.

The conservation of biodiversity through modern and traditional means has become a priority at many levels, from local governments to communities. Since 2002, more than five upland forests have been placed under protection, more than 15 new marine protected areas have been established, and the designation of two UNESCO Biosphere Reserves has occurred, all with NGOs and communities central to the process. Perhaps the greatest example of this can be seen in the effort currently being made by the Yela Environment Landowners Authority (YELA), a grouping of 13 families who have chosen to set aside their ancestral lands – one of the few remaining roadless areas in the FSM – for the purpose of conserving one of the 24 Priority Areas of Biodiversity Significance (ABS) identified in the federation. It is truly a groundbreaking community-led effort with a host of heavy precedents associated with it as the conservation work proceeds

Since 2002, more than five upland forests have been placed under protection, more than 15 new marine protected areas have been established, and the designation of two UNESCO Biosphere Reserves has occurred, all with NGOs and communities central to the process.

Threats

In the broadest terms the FSM currently faces an uprecedented conglomeration of different localized and global pressures which are pressing ever more diligently upon the unique and fragile biodversity of the federation. A quickening of the pace of everyday life, the conversion and deepening immersion into a market economy dependent upon outside inputs, and the movement toward extrapolated infrastructure construction are the trifecta of 21st Century life that form the triangle of sustained development facing the FSM today. Various reports and assessments have identified the primary threats to the structure of FSM's ecosystems and functioning biodiversity, including: The Climate Change National Communication – 1997; The National Biodiversity Strategy and Action Plan – 2001; The FSM Strategic Development Plan – 2003; The Blueprint for Conserving the Biodiversity of the FSM – 2003; and The State of Coral Reefs in the Pacific Freely Associated States – 2008. These primary publications document the fact that both environment and culture have always been important to the FSM in its historical development objectives and the federations' international relationships, and they express the major threats to biodiversity, and causes of biodiversity loss as thus: Overexploitation of biological resources; Habitat loss and deforestation; Land degradation; Climate change; Pollution; Spread of alien invasive species; and, Infrastructure development and urbanization. These seven bio-security factors, as we shall call them, are the critical threats to the biodiversity of the FSM (TNC 2003), are all highly variable and are taken as a representative factor across the range of environmental disturbances

noted and/or highlighted by the major national documents reviewed, most of which were prepared through a very broad, multi-stakeholder input process in the FSM at different points in time.

Many species in FSM are in serious decline or are on the precipice of extinction due to the main causes of biodiveristy loss listed above, as well as the fact that little is actually known about them. **Table 13** below highlights some of the fauna and flora that are threatened in FSM today. The table also reveals gaps in needed taxonomic data in freshwater ecosystems in particular. In terms of mammals, for FSM nearly all of the fuit bats, or flying foxes, are threatened or endangered, including, the Ulithi fruit bat, the Yap fruit bat, the Kosrae fruit bat, the Chuuk fruit bat, the Pohnpei fruit bat, and the Mortlock fruit bat (Falanruw 2002). Other mammals under threat in the FSM are the Caroline sheath-tailed bat, whales – including the blue whale and sperm whale, and the very rare Dugong (Falanruw 2002, IUCN 2008).

Vascular plant species in FSM are extraordinarily diverse and unique. Of the identified species of plants, the following are currently listed or considered as vulnerable or threatened: *Terminalia carolinensis*, Tree ferns, Cycadeceae, Looking-glass tree (*Heritiera longipetiolata*), Ivory nut palm, Korom (*Parkia korom*), Ehphorbiaceae, Mahogany, Pitcher plants and Orchids (Falanruw 2002).

Birds in the FSM represent the greatest number of terrestrial vertabrates, and their declining numbers and mounting threats are sobering. Amongst the avian fauna that are facing greater pressure for existence are the Pohnpei Mountain Starling, the Pohnpei Short-eared owl, the Caroline Ground-Dove, the White Throated Ground Dove, the Micronesian pigeon, the Chuuk Monarch, the Yap Monarch, the Bristle-thighed curlew, the Large Pohnpei white-eye, the Chuuk or Faichuk white-eye, the Plain white-eye the Yap olive white-eye, the Rufous fantail and the Micronesian kingfisher (Falanruw 2002, TNC 2003). Much of the threat comes from loss of habitat due to deforestation and fragmentation, as well as hunting (TNC 2003).

Reptiles in FSM, expecially the sea turtles so important to the culture, are also threatened. These include the Leatherback sea turtle, the Pacific green sea turtle, the Pacific hawksbill turtle, the Olive ridley sea turtle, crocodiles and Monitor lizards. The Monitors are found mostly on the island of Kosrae, where they are generally regarded as a nuisance and killed at will. Climate change and other anthropogenic activities on coastal areas are combining to decrease beach and nesting site availability for the sea turtles.

As for crustaceans, only one is currently listed for the FSM and it is the Coconut crab. Coconut crabs also face an altering environment caused largely by human development and degradation of habitat from infrastructure projects ongoing. Several species of molluscs (Land snails) are also endangered or critically endangered, according to IUCN. They are the *Partula guamensis, Partula emersoni and the Partula martensiana*, found mostly in the tropical rain forests of Pohnpei and Kosrae (Falanruw 2002).

TABLE 13: Summary of Threatened Fauna and Flora of FSM from Selected Taxonomic Groups

Group	Species in the 2008 Red List of Threatened fauna and flora of FSM	
	Number Assessed *(no. of endemics in parenthesis)*	Number threatened *(no. of endemics in parenthesis)*
Marine Fish	68 (0)	13 (0) [19%]
Freshwater shrimps	-	-
Birds (residents only)	136 (17)	11 (11) [8%]
Freshwater crabs	-	-
Mammals	25 (4)	6 (5) [25%]
Dragonflies	-	-
Butterflies	-	-
Evaluated invertebrates	489 (61)	108 (13) [22%]
Freshwater fishes	-	-
Reptiles	4 (0)	3 (0) [75%]
Amphibians	-	-
Evaluated vertebrates	233 (21)	33 (16) [1%]
Evaluated Flowering plants	8 (3)	6 (6) [75%]

Sources: IUCN (2008) and IUCN FSM (2000).

Although there is scant information available and fewer such listings, the many sharks in FSM waters should also be considered as threatened (Falanruw 2002). There is growing evidence that sharks are likely to be in he first round of marine extinctions caused by human activity, as they are vulnerable to overexploitation due to their longevity, late maturity and slow reproductive rates (Falanruw 2002). In some areas of the FSM such as Fais, Yap, sharks are taken for subsistence purposes. While locally important, the numbers taken are fairly limited. In contrast, a great many sharks are taken by foreign fishing vessels as by-catch of other fisheries or purposely for the shark fin trade (WildAid 2002). This is quite common in the FSM, even amongst the licensed fishing vessels, many of whom unload thousands of shark carcasses on the docks of Pohnpei, Chuuk and Yap. This says nothing of the hundreds of illegal fishing operators in the vast FSM waters (Greenpeace 2009).

This leads us to a discussion on the many tuna species within FSM, which comprise the last great natural tuna stocks remaining in the world (FSM 2009). Moreoever, most of the people of the FSM rely heavily upon local fishermen to catch and sell tuna for availability in communities and the local markets. Unsustainable – and illegal – harvesting of the greatest resource the FSM has continues, with foreign fishing fleets continuing to expand (ABC 2009) – and FSM continuing to grant more fishing licenses for desperately needed national and state revenues to help defray government operations. Already, bluefin, yellowfin and bigeye tuna are at or

over maximum sustainable yields (WCPFC 2009) in the western Pacific Ocean, of which FSM is the largest and most central nation. Greenpeace International has called for high seas conservation pockets to stem the tide of depletion, and is amongst a chorus of institutions and scientists who have called for immediate halt of fishing for bluefin tuna, and a significant reduction in the allowable catch of bluefin, yellowfin and bigeye tuna in order to avoid long-term fisheries collapse.

Box 1. Keystone Species

Native mammals of the FSM include five species and subspecies of fruit bats of the genus *Pteropus* and a sheath-tailed bat [*Emballonura semicaudata]*. Taxonomic studies of the fruit bats are not complete, but all are presently considered endemic species and subspecies. The *Pteropus* fruit bats (or flying foxes) are considered to be the premiere keystone species essential to the long-term survival of forests as they serve to pollinate and disperse seeds of forest species (Falanruw 2002) and maintain apex functionioning of the upland and montane cloud forests in Kosrae, Pohnpei, Chuuk and Yap. Although they are not eaten within the FSM – unlike in Saipan and Guam, where the Chammoro people regard them as a delicacy and will pay high prices – they are nonetheless threatened due to habitat loss from climate change and clearing of forest for agriculture and other development, as well as poaching for export. Worldwide, fruitbats are covered and/or protected under CITES and the US Endangered Species Act. In the FSM, several are listed on the IUCN Red List, which generally means a species is on a path toward extinction unless measures are taken to abate their decline. A keystone species is regarded as a primary indicator of overall biodiversity health.

Kosrae Fruit bats relax at the small coral island of Yen Yen, one of a handful of known colonies on the island.

As for the Pacific or, Caroline (Falanruw 2002) sheath-tailed bat (Emballonura semicaudata), they are more rare and less well known in the FSM. Although they were once widespread and common in Polynesia and Micronesia, their numbers have declined significantly. The species has gone extinct in Guam, Anatahan, Dublon (Chuuk Lagoon island), and Viti Levu. In the FSM it is now only found on Moen (Weno), Pohnpei, and Tol, and listed as endangered by IUCN (2006 IUCN Red List of Threatened Species.) The bat is small, ranging from 41-48 mm, and has limited ecological data available simply because it has been very little studied. Its faborite habitat is intact native forest and small colonies roost on the lower truncks of trees, under the cover of large branches (O.L. Wortel, pers. obsv.), which protects them from strong winds. Because of the Pacific sheath-tail bats' dependence on native forest for food, the persistence of a population is threatened by deforestation, especially on small islands. Without forest protection, the bats are easily blown away from their foraging habitat (and food) by strong winds. Slow reproductive rates combined with the threats of feral cats, deforestation and increased disturbance to add to the risk of extinction of these distinctive bats. The Pacific sheath-tail bat is the only insectivorous bat that is widely distributed in Polynesia and Micronesia. In addition to their cultural significance, insectivorous bats such as the Pacific sheath-tail bat play an important role in maintaining forest populations of flying insects. Palau and Fiji have the most numerous populations of this species (Palmeirim *et al.* (2007).

III Current status of National Biodiversity Strategies and Action Plans

In review, the FSM NBSAP is a meticulously considered, well-crafted environmental policy document. It is rather broad in its reach and intended scope, covering a wide range of economic, social and environmental development processes, and thereby, is a rather valuable cross-sectoral policy tool for decision makers. As a guiding document for earnest ecological thinking within the context of economic development it serves its purpose well. But the primary question here remains: Has the NBSAP in fact served its intended purpose? Largely, the answer is yes, it has. The NBSAP was nearly completely integrated into the FSM Strategic Development Plan, 2003-2024, so much so that the Environemnt Strategy matrix found in the SDP nearly mirrors the NBSAP in terms of its overall goals and objectives. Moreover, it was also because of the NBSAP that one of the greatest – it is likely the preeminent environmental guide in the FSM - national environmental documents was produced, *A Blueprint for Conserving the Biodiversity of the Federated States of Micronesia*. The Blueprint expresses the outcomes of a massive two-year multi-stakeholder process undertaken by individuals within all levels of government, the U.S. Forest Service, The Nature Conservancy, university scientists, and local scientists that identified the 130 top Areas of Biodiversity Significance throughout the 607 inhabited and uninhabited islands of the federation.

The NBSAP has also served as an organizational tool and coordinating mechanism for the various players in the nation to rally around in working toward widely accepted conservation goals. Additionally, the NBSAP has helped to foster a coordinated and focused collection of conservation NGOs throughout the nation, which combined are doing much of the frontline work to protect resources and livelihoods throughout the country. Importantly, these NGOs collective bring in much-needed revenue and create "green" jobs centered around the themes of the NBSAP. For example, official figures for 2007 show that NGOs brought in or utilized over $3 million for NBSAP-related programs and projects, often creating direct employment within communities and states. The Micronesian Conservation Trust – for all intents and purposes, the financing arm of the NBSAP/CBD in FSM (Theme 11) – is adding to this, contributing roughly $419,000, $548,000 and $1.5 million to the economy and toward conservation from 2007-09. This is a growth area of the economy that should not be underestimated.

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While we are on this point, it should be noted that MCT is one of the crowning policy element achievements of not only the FSM, but the entire Micronesian region. Established in 2001 as a long-term financing mechanism for ongoing conservation initiatives and achievement of the Convention goals, implementation of the NBSAP is in many ways being assumed by the institution – serving a multitude of island nations. MCT provides a forum to bring together the national, state, and local governments with private enterprises and non-government organizations to collectively address the challenges of natural resource management, form public-private partnerships, and share experiences and best practices.

There have also been challenges in implementation of the NBSAP. Areas of Theme 1: Ecosystem Management in particular requires greater effort. This includes broad-scale long-term monitoring of forests through aerial photography, ground-truthing and satelite mapping, as well as closer scrutiny and monitoring of changes on coastal and marine ecosystems. The SD Council, an interdepartmental, intraagency advisory board established by the President and chaired by the Vice President of the nation, oversaw much of the initial NBSAP development process, but has since – despite various recommendations for enhanced authority and improved coordination – been somewhat disorganized and unfocused on NBSAP monitoring activities. This is quite an essential point, as the SD Council is a national body that can and should have top-level authority over biodiversity issues, with an eye toward continual integration of the NBSAP themes throughout national development processes. There should also be more emphasis placed on integrating the most progressive technologies available today toward better ecologically sustainable industry development, including waste management (NBSAP Themes 5 and 7).

IV Sectoral and cross sectoral integration of biodiversity considerations

Clearly, achieving the objectives of the Convention, and in particular the 2010 target and goals and objectives of the Strategic Plan, will be impossible without engaging the main sectors and key actors that have impacts on the conservation and sustainable use of biodiversity. Of particular importance for the FSM is the Compact of Free Association with the United States. The use and implementation of the roughly $100 million annually, 30% of which is required to contribute toward socio-economic development in the form of infrastructure improvements through the year 2024, has a great bearing on ecological sustainability over the long term. Table 15 below highlights this.

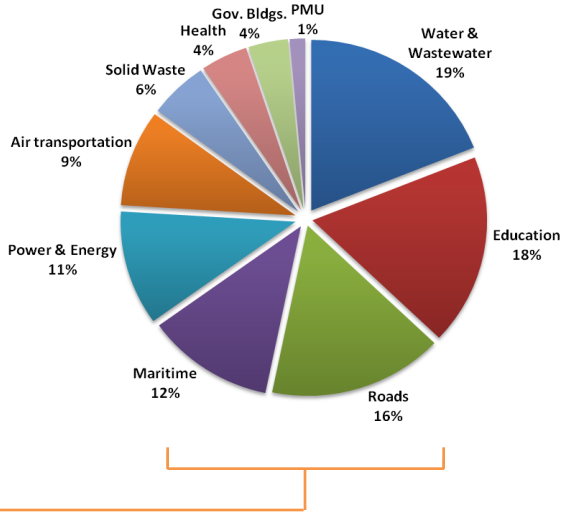
The Infrastructure Development Plan (IDP) has profound implications for biodiversity considerations in the nation over the long term, and how well the IDP incorporates these considerations in implementation will largely determine the overall achievement of the convention goals. Foremost, the IDP is the major component of annual funding to the FSM through the Compact with the United States, and therefore adds significantly to short and medium term economic growth. Additionally, if implemented properly, this far-reaching sectoral plan will also be a significant solution to many of the current urban and rural pollution problems discussed as primary threats to biodiversity. For example, Water Supply/Wastewater and Solid Waste Management are two of the long term planned investments for the FSM under the auspices of the IDP. Currently, wastewater and sewage are emblematic features of degraded terrestrial and marine environments around the more populated centers of the FSM. The IDP therefore is an excellent tool to address these issues, and effective implementation of the IDP for these components is a

The IDP also has an inherent ability to conversely affect whole ecosystems in negative ways, given the expedience and prerogative of money and donors and the destructive machines and tools that infrastructure development requires.

necessity. However, the IDP also has an inherent ability to conversely affect whole ecosystems in negative ways, given the expedience and prerogative of money and donors and the destructive machines and tools that infrastructure development requires. It is here that the appropriate and broad-scale utilization of Environmental Impact Assessments (EIAs) comes into play in the FSM. Title 25 of the FSM Code has an extensive, clear and thorough chapter dedicated to EIAs and their use for more than 25 identified types of projects; it basically covers every project imaginable in terms of utilization and impacts on all terrestrial and marine ecosystems. Challenges do however remain in the FSM. Often environmentalist concerns are glossed over as a mere formality. There also exists a real lack of authority and enforcement of the FSM Code and the state regulations when it comes to EIAs as well, with economic development and jobs taking priority.

TABLE 15: Infrastructure planned investments through 2023 for FSM

Sector	Amount ($ millions)
Water supply/wastewater	141.9
Education	135.4
Roads/pedestrian facilities	120.9
Maritime transportation	88.5
Electric power	81.1
Air transportation	68.4
Solid waste management	40.8
Health	32.5
Government buildings	27.3
Program management	10.7
Total:	**747.5**



Source: FSM SDP, Volume III: Infrastructure Development, 2003

As for the so-called ecosystem approach, it certainly is alive in the FSM at higher policy levels and decision making. The ecosystem approach stresses the importance of preserving in various ways the natural ecological structures and functions of habitats so as to safeguard beneficial natural values and processes known as *ecosystem services* (e.g., clean air and water, arable land, integrated habitats, etc.). This approach is best reflected within the FSM through the environment strategy matrix within the SDP. It can also be seen clearly in some of the major policy documents actively being promoted and integrated into the overall national development agenda. These include the FSM Fisheries (Tuna) Management Plan and the FSM Coastal Fisheries Consortium, the Sustainable Land Management Program for Forests and the Development of Sustainable Agriculture in the Pacific program, and key integrated, cross-cutting national policies for Energy, Climate Change and Waste Management.

V Conclusions: progress towards the 2010 target

The concept of "sustainability" in the development context became widely discussed as a result of the report of the Brundtland Commission, established by the United Nations. The crux of that commission's focus on the relationship between economic development and environmental protection was the concern for intergenerational equity. The current generation, in striving for economic development, was cautioned to treat the natural resource base in such a way as to preserve means for future generations to meet their own needs (World Commission on Environment and Development 1987; World Bank 1996; Gale, 2008). On small pacific islands, either something is sustainable or it isn't. Results, or in this case, repercussions appear quickly, particularly when it comes to ecologies. For example, a segment of road bulldozed on Kosrae in the morning silts in a portion of the lagoon with the afternoon rainstorm, and you have no fish for dinner because fish don't like the silt. Thus it is that one of the most fundamental issues in the realization of biodiversity conservation is the value that we place on the environment, in all its aspects. This is not just about material gains and human centered development, but values based on a deep-seated respect for the environment, based on a moral standard. Aldo Leopold developed a land ethic based on the principal that a thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise. This is a basic premise that fits well into both the modern and historical conservation ethic that can be found within communities of the FSM; it also encompasses the primary goals of the Convention and progress toward the 2010 Target: conservation, sustainable use, and the sharing of benefits derived from nature.

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In terms of conservation, the FSM is at the forefront globally with the Micronesia Challenge, a call to action to institutionalize long-term preservation of forests and reefs, which will help to provide a balance to the long-term economic development objectives. More and more forest reserves and marine protected areas led by conservation groups and communities are being planned and implemented each year, organized increasingly through such efforts as the national Protected Area Network (FSM PAN). Programs such as the EU-funded Conservation and Environmental Protection Program (CEPP) also add value: in 2009 alone, 14 projects throughout the FSM were funded with a total value of $626,403.

As for the sustainable use of resources, the national government, and in particularly the Department of Resources and Development, has been an instrumental stakeholder in helping to promote this objective. Conservation after all, is ultimately a means by which to benefit the human inhabitants of particular ecosystems; conservation is the means to the end of sustainable use. And in FSM, as elsewhere, when we talk about sustainable use, we are talking about community and rural livelihoods. It has been recognized in the FSM in its assessment on sustainable development commissioned by the Department of Economic Affairs (2006)

that it is crucially important to sustain ecosystems over time if a true and broad economic and social well-being is to be attained. This means creating jobs and income around not only conservation initiatives – what one might call "greening" the economy – but also using biodiversity over time to create revenue streams into the macroeconomy. An excellent example here can be seen in the public-private partner ship that is working toward an eventual privatization of a national aquaculture facility in Kosrae. The facility – one of the premiere such facilities in the tropics – is designed for raising giant clams, and has now started replicating and growing certain hard and soft corals for export, mostly to the aquarium enthusiast markets on the west coast of the U.S. and western Europe. This operation, now known as Micronesia Marketing and Management Enterprises, employs a minimum of five full-time staff and is now not only bringing in desperately needed cash into the economy, but it is also now expanding into the communities, where selected fishermen and farmers are assisting the production of both coral and clams in in-situ grow-out sites on the reefs. Under the arrangement, 10% of all corals and clams that are raised are placed back into the wild. This is an example of sustainable use that is both good for the economy and good for the environment. The project is still not fully realized – can aquarium fish be exported sustainably without significant biodiversity loss; can it be done without taking away one of the resources that the eco-tourism operators rely upon; can they be successfully aquacultured in captivity? – these are the sorts of subsidies and eco-friendly industries that equatorial Pacific Island countries like the FSM are trying to support in trying to achieve the aims of the Convention.

Trends for species diversity remains precarious, perhaps stable at best at this point in time. Marine species in particular are facing huge pressures. Turtles and sharks face mounting global threats to their survival, often beyond the control of local actions and policies; while localized actions reveal that near shore fisheries are being overfished at increasing rates, with several integral species facing imminent collapse if appropriate measures are not put into place in a timely and effective manner. Forests of the FSM, which exhibit some of the most unique and rare types in the world, must also receive greater human support for their sustained ecological productivity. Water quality is also a mounting issue as urbanization, homesteading and western lifestyles creep further into the rural areas of the country.

There have been some essential lessons learned over the last decade during implementation of the Convention: protect biodiversity by protecting livelihoods; updated biome information is a priority; utilizing all available capacity (including NGOs and the private sector); enhanced NBSAP monitoring using targets and indicators; the continued need for mainstreaming of biodiversity considerations; and greater authority and focus of the NBSAP implementation council moving forward.

Future priorities should include a cross-sectoral review of the NBSAP for monitoring and integration purposes, addressing key gaps in information for freshwater fauna, invertebrates, threatened plants, updates on the status of priority ecological sites, updated aerial photography to determine native forest cover, updates on the status of endangered species including assessments of birds, fruit-bat populations and the Caroline sheath-tailed bat, and continued training and capacity building in methods of natural resource assessments and

species surveys, biodiversity valuation methods, environmental impact assessments,and the integrated ecosystem approach, amongst others.

As FSM progresses into the second decade of the 21st century, there are unmistakable signs of environmental stress and degradation of the federation's biological wealth. Ultimately, biodiversity loss must be seen as an economic loss, an opportunity lost. The value of the continuously free ecosystem services that nature provides is nearly priceless. Yet we can measure the economic value in a myriad of ways. Perhaps it is hard to judge the value of a clean air molecule, or decide how much a pool of clear, glistening water should cost, fresh shrimp in a stream, or even the sight of a blue sky and the distant break of the reef below without smog clouding the image. What is the value of a turtle nesting on a beach, even if you don't know it, cannot see it? The answer is that on the face of it you cannot put a price on it; not to say that it does not have value, because it obviously does; but value is subjective. But what we can affix numbers to is the amount of fish sold in a fish market, the price of a gallon of pure water, the percent of GDP that fishing licences contribute to the economy, the number of tourists that paid to dive in a reef passage or swim in a pool below a waterfall. These are what are known as ecosystem services. And the degradation of ecosystem function as it moves further from the climax state has an inverse relationship with their value over time, especially to human communities.

Many people in the FSM face hardship and poverty (Nimea, 2008). And the incidence of the Basic Needs Poverty Line – the measure of relative poverty and hardship in the FSM – is growing: between 1999 and 2005 the BNPL increased from 27.9% to 32.2%, with some states seeing a significant worsening of the poverty situation (Abbott, 2008). Additionally, commensurate with a buy-in to a widening capitalistic lifestyle, the gap between the wealthy and the poor is also growing. The most recent UNDP analysis purports that the weekly household expenditure was almost ten times higher in the richest 10% than in the poorest 10% of families. Higher rates of poverty – one in three people fall below the BNPL in FSM (Abbott 2008) – lead to greater dependance on ecosystems (TNC, 2002, CCD, 2006) by the underclass in particular. Combined with low wage rates and few job opportunities (35% unemployment), and these pressures in turn lead to further extraction of local resources and biodiversity loss, which in turn may likely result again in a deepening and broadening of the poverty index for the nation.

Source: FSM 2005 HIES Analysis, 2008

Chapter I
Overview of Biodiversity Status, Trends and Threats

Source: Yap Art Institute

"In a blistering speech on the third night, the winds and rain gusting at his back, Senator Noah Idechong captivated and urged his fellow conservationists to take the destiny of their islands into their own hands. 'The problem is solved from within; it does not come from without. Outsiders will not be our benefactors, but our collaborators.... Indifference and external factors are a big influence, but the problems that we face today are ours and so are the solutions. We must take ownership of our destiny, we must decide what we must do, get the help, and then do it,' he said."

From an Article Entitled, "Yap, FSM: Micronesian Conservationists Meet"
(Source: Pacific Magazine, 8 April, 2005)

"A thickness of three primary sounds filled the jungle – chirping crickets on the forest floor, singing birds in branches overhead and the steady gush of the river over rocks, through pools and around fallen trees. The air they breathed as they marched through the understory of tree ferns was crispy and green. In this riparian zone, in this forest, on this island, within the eastern Caroline Islands of the equatorial Pacific it was likely some of the cleanest oxygen on the planet."

From a short story, entitled, "The Hunt for the Wild Boar", by O.L. Wortel.
(Source: Micronesian Alliance, 21 September, 2005)

Chapter 1

1.1 Introduction

This chapter provides a general overview of FSM's rich biological diversity, its status, trends and threats. Accordingly, it is meant as a general overview of biodiversity in the islands and elsewhere to inform decision-makers and other stakeholders, rather than to provide an exhaustive, detailed, scientific documentation of the status of the country's biological wealth. In this vein, it is also important to note that although this chapter contains necessary and valid scientific information, it is not presented in a completely scientific manner. Rather moreso, it is presented in a format and language that seeks to inform and aid the understandability quotient as much as possible so that decision makers and other non-technical individuals can appropriately read and think about and, hopefully, act upon those conditions that merit attention when it comes to the discussion of biodiversity and the inherent wealth derived. Particularly as it relates back, obviously, to the provisions and goals of the Convention on Biodiversity. The chapter is thus structured as indicated above in the Table of Contents to concur with the approach adopted by the Biodiversity Conservation Action Plan which covers forest, inland wetland, coastal and marine and agricultural biodiversity – inlcusive of the singular ecosystems and species within them that collectively comprise a functioning biome.

Although the FSM has very individual and unique biological and geographic differences between each of its four states seperated by vast distances of ocean, atolls and reefs[1], this report, and in particular this chapter, rather than examine each of the states in detail, provides an organized glimpse of the nation as a whole, while highlighting some of the particular biomes and facets of biological significance and the determining issues that affect them.

By almost all accepted economic and financial barometers, the FSM is a developing island country[2]. Today, the Federated States of Micronesia aspires to become more self-reliant commercially, while it concurrently accepts greater financial inflows – and the resulting development pressures - from an ever increasing international donor base. The people living on the islands of the FSM continue to strive toward an expanded and increasingly pervasive capitalistic lifestyle, influenced largely by the free market values of the United States government[3]. Moving away from a sharing, familial country to one

[1] The marine area within the FSM's Exclusive Economic Zone (EEZ) totals over one million square miles (2.6 million square kilometers).

[2] Nimea, F., 2006. *National Assessment Report on Sustainable Development Strategies in FSM*, pp. 13.

[3] The FSM has been inextricably linked to the United States since its inception as an independent nation in 1986 through the Compact of Free Association, an agreement that yields exclusive military control of the air and water ways and access to the land when necessary in exchange for current annual subsidies of about $100 million per year through 2023.

more and more based upon individual gain and need has resulted in a widening division of wealth[4], which in turn – combined with the ripple effects of the global economic downturn – has led to exacerbated pressures on local ecosystems for survival in a capitalized economy. Bringing this model up to the government level, the primary local source of revenue for the nation remains through the sale of tuna fishing licenses and the foreign fleets in FSM waters are growing per the pecuniary prerogatives of a developing nation. Development pressures therefore are on the upswing.

In concert, the unique and fragile ecosystems and the plethora of species that the 12 principle biomes of the FSM harbor and generate, have by all relevant international conservation measures produced one of the world's singular biodiversity hotspots[5]. The extensive reef and forest biomes of the FSM also provide a major sink capacity for the world's total human-sourced greenhouse gas emissions of carbon dioxide, methane, nitrous oxide and other greenhouse gases (FSM CCNC, 1997), while at the same time are under severe and mounting global climate change pressures. Monumental and significant environmental protection efforts abound[6]. Indeed, the culture carries forward a measured respect for nature in its daily lifestyle. Thus both the development and the conservation arenas provide the juxtaposition that ultimately measures the historical crux at which this nation finds itself, and leads to the discussion and interplay on sustainable development, and if such a neat phrasing can indeed be achieved in reality. It is within this development and historical context that this chapter gives a current snapshot, if you will, of the rather unique and extremely fragile biodiversity – which of course includes the human inhabitants and their cultures – that struggles to thrive alongside an increasingly globalized sphere of influence on this part of the world.

In short, what are the status, trends and threats to biodiversity in the FSM? The status is more precarious than ever, but with hope and dedication affixed alongside. The trends are – in the most general sense – toward a decline in biodiversity. And the threats, as discussed in further detail in this chapter, are perhaps more numerous and severe than ever.

[4] Based on the recent FSM-UNDP 2005 Household Income and Expenditure Analysis, which concludes that "there is a wide variation in expenditure levels between the poor and non-poor households" in FSM (pg. 4, paragraph 22).

[5] The Conservation International (CI) website, in its Biodiveristy Hotspots page, states that the Polynesia-Micronesia Hotspot "is the epicenter of the current global extinction crisis."

[6] One of which is the singular Micronesia Challenge, discussed in greater detail in Chapters 2 and 3 of this report.

1.2 An overview of FSM's biodiversity

1.2.1 FSM's unique biodiversity

The Federated States Micronesia, as a biome, houses some of the most superlative biodiversity on the face of the earth. Stretching from the middle of the Pacific to Southeast Asia and eclipsing the size of Western Europe, the FSM as part of the Micronesian sub-region is one of the preeminent global biodiversity hotspots strattling the equator[7]. These oceanic islands of the FSM, in the Caroline Islands, thus harbor some of the most biologically diverse forests and coral reefs in the world (TNC 2003). Over 1,239 species of ferns and flowering plants have been described in the FSM. Approximately 782 species are native, including about 145 species of ferns, 267 species of monocots and 370 species of dicots (Fosberg et al 1987, Falanruw 2002). More than 200 of these plants are found nowhere else on earth (NBSAP 2002)[8]. More comprehensive studies and assessments ongoing throughout the nation's forests are likely to add significantly to this list of unique diversity[9]. Its terrestrial ecosystems harbor unique avian, mammilian, reptilian and other species, including owls, flying foxes, parrots, giant geckos, skinks, dragonflies and snails: over 27 species of reptiles and amphibians, most of them native and at least 4 endemic (WWF 2009); five endemic species and subspecies of fruit bats of the genus *Pteropus* and a sheath-tailed bat of the genus *Emballonura;* and, 119 species of birds, including 31 resident seabirds, 33 migratory shorebirds, 19 migratory land or wetland birds and 5 vagrant species (Engbring et al.1990)[10]. When one considers the land area constituting the FSM's 607 islands is only 4,840 square km (FSM CCD 2006), it makes the compact and thriving biodiversity on this group of centrally positioned islands within the greater Micronesian sub-region as unique and spectacular as they are fragile and threatened. Its coastline is about 3,300 nautical miles (FSM NARSD 2006). Its reefs, estimated at 14,517 km2, providing coastal protection and the source of livelihood for a majority of FSM citizens, are home to more than 1,000 species of fish, more than 350 species of hard coral (NBSAP 2002, FSM NARSD 2006),

[7] A wide range of ecosystems are found throughout this hotspot. There are 12 principal vegetation biomes, the most widespread of which is strand vegetation, consisting of salt-tolerant plants found along the shores of most Pacific Islands. Other principle vegetation associations include mangroves, coastal wetlands, tropical rainforests, cloud forests, savannas, open woodlands, and shrublands (CI 2009).

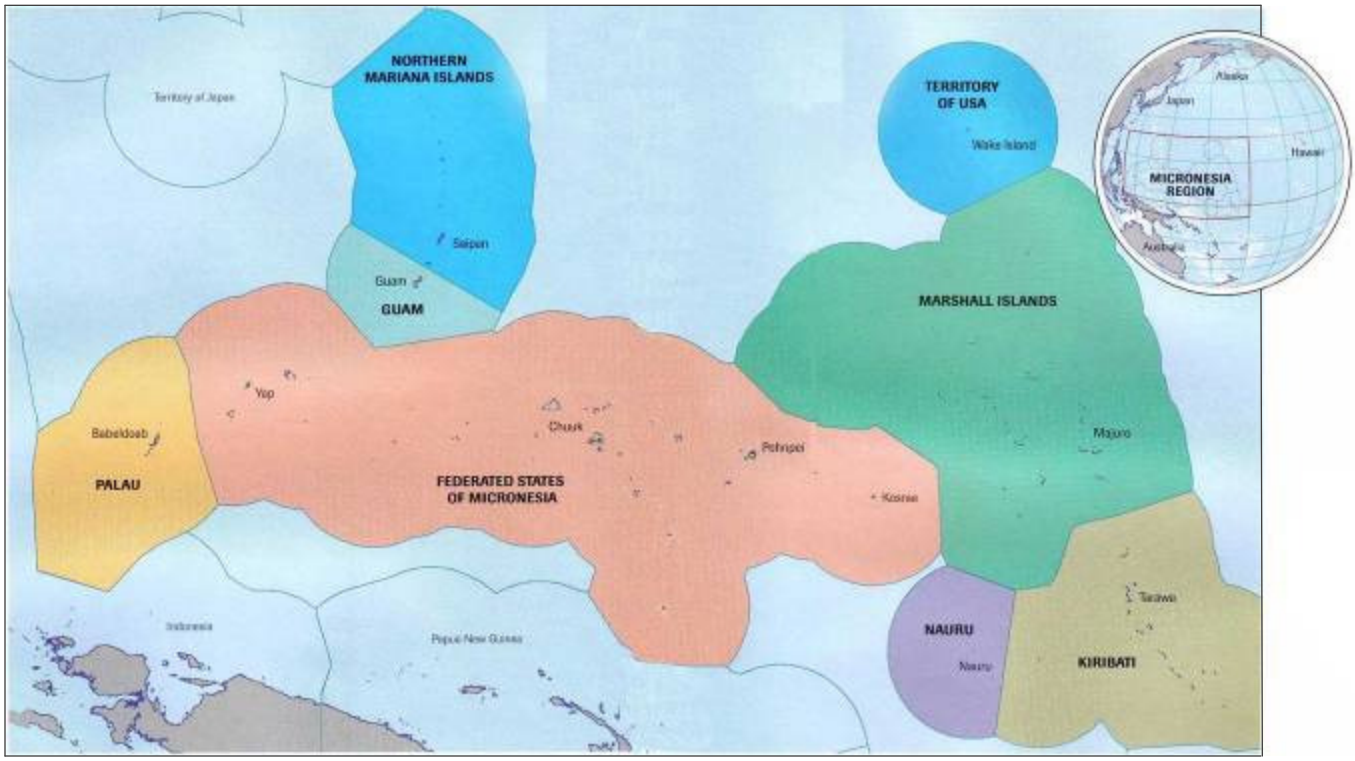
[8] Michael Balick, Director of the Institute of Economic Botany at the New York Botanical Garden, who is overseeing a decade-long study of the medicinal plants of the FSM, stated an a recent interview in EarthSky Interviews (www.earthsky.org) that it is likely that "in Micronesia, 79% of the native plants there are endemics, meaning found nowhere else on Earth. So if you judge biodiversity hotspots by endemic plants per hundred square kilometers, Micronesia falls in the top 10 in the world. "

[9] As indicated by both Balick (*see Note 7 above*), and Katie Friday, Cooperative Forester for Pacific Islands and Hawaii, USDA Forest Service, Institute of Pacific Islands Forestry, who is coordinating a State-Wide Forest Resource Assessment and Forest Resource Strategy to be submitted by the FSM to the US Secretary of Agriculture by June 18, 2010.

[10] Each State of the FSM has at least one, if not several, endemic avian species, which are either extinct or are declining in numbers (Falanruw 2002).

and 1,200 species of mollusks (FSM PNRCCD)[11]. Beyond, the marine area within the FSM's Exclusive Economic Zone (EEZ) totals over one million square miles (almost 3 million square kilometers) **(Figure 1)** and includes a multitude of abundant and varied life and natural resources (UNCCD 2002). Of the hundreds of islands within this vast seascape, a number of the larger islands, which represent a minority, are relatively large and mountainous, while the majority are small, flat coral atolls or raised coralline islands, which have little or no human inhabitants[12] but instead serve as hubs of habitat and regeneration for a mutitude of species, including sea turtles, sea birds, sharks, crabs, clams, rays, fish and many other species that are able to thrive in the tropical equatorial life belt of the world[13]. Indeed, this massive area nearly the size of the continental United States is spawning gound and habitat for much of the worlds' healthy remaining reef, marine and paelegic fish populations that are also increasingly exposed to the food needs of a rapidly enlarging global human population[14].

Figure 1: Map of FSM, Inclusive of the Federation's Exclusive Economic Zone



Source: The Nature Conservancy Micronesia Action Plan, Fiscal Year 2004 to 2008.

[11] Rapid Ecological Assessments conducted in all the States from 2005-07 identified more than 355 species of fish and coral not previously known to occur in the FSM, including at least one new species of fish discovered in Pohnpei (CSP 2006, Donaldson et al., 2006) and possibly one new species of coral and three new species of fish discovered in Yap (YapCAP 2007).

[12] Approximately 65 of the islands are inhabited (FSM SDAR 2006).

[13] There are 30 high islands, one raised coral island and 33 atolls whose individual islets bring the total number of islands to over 600. These islands range from islets barely above sea level to the high island of Pohnpei which reaches 791 meters above sea level (FSM PNRCCD 2002).

[14] It is a well-known and often repeated fact that the FSM is home to the largest healthy migratroy tuna fish stocks (FSM Gov. 2009) remaining in the world's oceans. These fish stocks are also being over-harvested – through both legal and illegal means - by countries such as China, Japan, the U.S., Korea, Taiwan and the EU (Greenpeace 2009).

It is thus that the terrestrial and marine ecosystems within this massive biome of sea and land largely provide the basic needs of the inhabitants that have relied upon and continue to rely upon the fringing and barrier reefs, the blue holes, the coral gardens, the reef flats and sea grass beds, the beaches, the estuaries, lagoons and bays, the mangrove swamps and forests, the fresh water swamps and forests, the rivers and aquifers and the mountain and cloud forests for nearly every need imaginable. Indeed, the biodiversity and natural heritage of the FSM are both globally significant *and* the foundation for the country's long-term economic self-sufficiency. Maintaining the habitats and ecosystems that nurture this diversity is crucial for improving the people's quality of life and sustaining the country's rich traditions (FSM NARSD 2006).

1.2.2 Geo-evolutionary history

The FSM includes the most geographically and culturally diverse part of the greater Micronesian region (CCNC 1997). Millions of years ago, volcanic activity created the islands and atolls of the FSM. Today, mountain peaks fringed by coral reefs thrust up out of clear blue Pacific waters. In other places atolls are all that remain of islands that sunk beneath the surface, leaving rings of coral barrier reefs around coral and sand lagoons. Located in the Central and Western Caroline archipelago, these volcanoes now consist of the four states of Kosrae, Pohnpei, Chuuk and Yap[15]. Endemism is high, in part because the islands are relatively close to the floristically rich regions of Southeast Asia and in part because of their isolation and great age (WWF 2009). With an Exclusive Economic Zone that extends from approximately 1 degree S to 14 degrees N latitude and 135 to 166 degrees E longitude. Relatively high rainfall (approximately 120-400 inches/year) and a humid tropical climate dominate the FSM due to its location just north of the equator and in the Pacific's Intertropical Convergence Zone (ICTZ) (TNC 2003). The islands of the FSM can thus be divided into two types: high volcanic islands such as Pohnpei Island, the Chuuk Lagoon Islands, and Kosrae Island, and Yap Island, which is sedimentary, and the low coral atolls, which include most of the outer island groups[16]. Pohnpei, Chuuk and Kosrae are characterised by steep, rugged uplands[17], whereas Yap Island has more gently sloping uplands, all of them surrounded by substantial, often swampy lowlands[18]. The islands were originally covered under mostly native forest cover, but the natural upland forests are disappearing rapidly, mostly due to conversion to agroforests and the resulting secondary vegetation (CCNC 1997). Typhoons are a dominant factor shaping biodiversity in Micronesia, however less so than a little farther north in the Marianas Islands and the Philippines, where typhoons are a regular (nearly annual) occurrence. Most typhoons in the region tend

[15] Yap holds the greatest biological diversity in the FSM due to its geography and geology (YapCAP, 2007).

[16] The main outer island groups are in Chuuk (the five regions known as Nomwunweito, Halls, Pattiw, Mortlocks and Chuuk Lagoon), in Pohnpei (the Eastern and Southern Island groups), and in Yap (Ulithi, Woleai and the Remetau Group of Islands).

[17] Pohnpei's oldest lavas date to over 5 million years B.P. and 60 percent of the island is steep and mountainous (Balick et al. 2009); for Kosrae – more compact - its rugged interior is nearly 70 percent steep and mountainous (Donaldson et al. 2006).

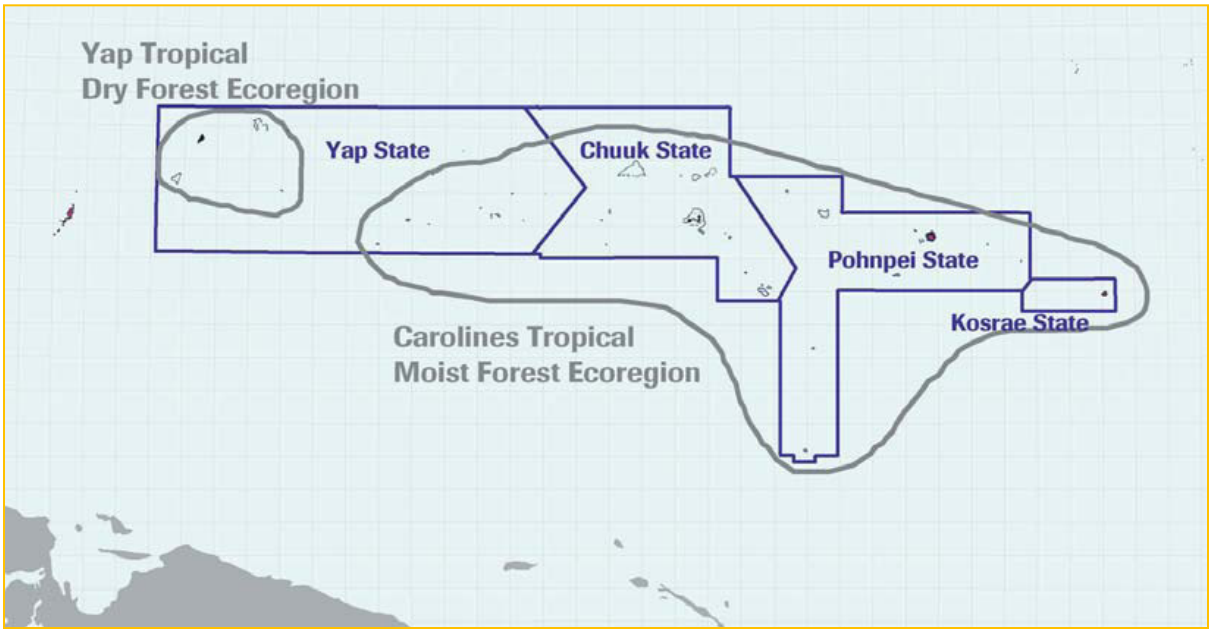
[18] Pohnpei and Kosrae are the third and fourth largest islands in all of Micronesia, behind only Guam and Babeldaub (Palau), and represent the number one and two highest mountain ranges, respectively.

to spawn in the eastern Carolines (northeast of Pohnpei and Kosrae) and then move off toward the northwest, allowing for taller forests in Pohnpei and Kosrae. Occasionally, however, typhoons do devastate the terrestrial and marine environments of the Caroline Islands, with major typhoons occurring infrequently (25-50 year events)[19]. Overall, these factors combine to create a high diversity of plant and animal species in the FSM within a relatively small land area (TNC 2003).

1.2.3 Ecoregions of the FSM

The FSM has two distinct ecoregions (**Figure 2**): the Yap Tropical Dry Forest Ecoregion and the Carolines Tropical Moist Forest Ecoregion (TNC 2003)[20]. The Yap Tropical Dry Forest Ecoregion contains the westernmost islands of Yap State (**Figure 3**). The dominant vegetation types are mixed broadleaf forest, swamp, mangrove, savanna, and agroforests. Vegetation maps from 1976 aerial photos indicate that wild forests cover about 40% of the land area of Yap (including mixed broadleaf forest, swamp, and mangrove) (Falanruw et. al 1987). Agroforests (tree gardens) cover another 26% of the land area, and about 22% of the vegetation is savanna. Scientists believe that prior to human habitation, broadleaf deciduous forests covered most islands within this ecoregion.

Figure 2: Map of FSM Ecoregions



Source: A Blueprint for Conserving the Biodiversity of the Federated States of Micronesia, TNC 2003.

[19] The most recent was Super Typhoon Sudan, when the eye of the climate event ripped through Yap over a 24-hour period on April 9-10, 2004, literally leveling the island's forests and reefs. A US FEMA team helicoptered in and stated at the time: "Stunning devastation. The landscape has changed considerably." (*Marianas Variety, "Typhoon Sudal Pummels Yap, Destroys 95% of Homes," by O.L. Wortel, April 11, 2004.*) Biodiversity has rebounded well over the ensuing years, likely in no small part due to the original near-climax function of most of the ecosystems affected.

[20] Much of this section is referenced from The Nature Conservancy's, *A Blueprint for Conserving the Biodiversity of the Federated States of Micronesia (2002)*, the seminal document on this discussion, as well as a foundational document regarding the ongoing biodiversity conservation efforts within the nation. It will be discussed in further detail in Chapter 2.

Bulldozing activities, wildfires, and agricultural burning endanger Yap's native forests and endemic species. Yap hosts at least three endemic bird species: a monarch (*Monarcha godeffroyi*) and two white-eyes (*Rukia oleaginea sp., Zosterops hypolais*) – as well as the distinctive Yap Cicadabird (**Figure 3a**) and four range-restricted birds (Stattersfield et al. 1998, Pratt et al. 1987). Two endemic species or subspecies of flying fox inhabit Yap State (*Pteropus mariannus yapensis and P.m. ulithiensis*) (Falanruw 1988). Both are listed under CITES (Convention on International Trade in endangered Species), and are covered under the U.S. Endangered Species Act; they are also protected by Yap State legislation. Hunting and typhoons (Hilton-Taylor 2000), as well as drought and habitat disturbance, threaten Yap's flying foxes. The marine systems of the FSM compose an enormous and largely unexplored resource, protecting some of the healthiest remaining populations of many globally threatened species. At least four of the world's seven species of sea turtles are recorded in Yap State, including the hawksbill turtle (*Erytomochelys imbricata*) and the green turtle (*Chelonia mydas*). In fact, the largest green turtle (*Chelonia mydas*) rookery remaining in the insular Pacific is found on several small islands of the atoll of Ulithi in Yap State. FSM's remote outer islands, including several atolls in Yap State also host a number of important seabird rookeries. The world's deepest and largely unexplored ocean trench, the Mariannas Trench, reaches its' greatest depth between Yap and the islands to the west.

Figure 3: Main Islands of Yap

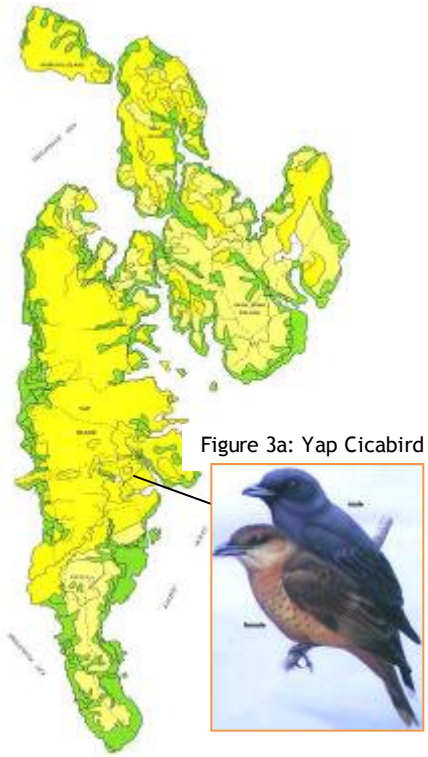


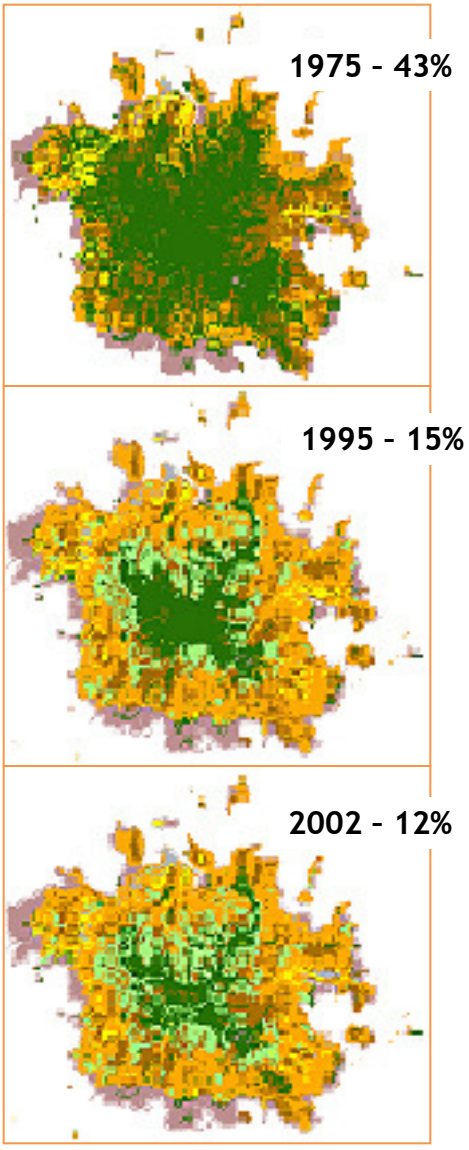
Figure 3a: Yap Cicabird

Sources: Soil Survey of Islands of Yap, FSM, USDA 1982, and Forest and Land Birds of the FSM, USFS 1998.

The Carolines Tropical Moist Forest Ecoregion contains the islands in Kosrae, Pohnpei, Chuuk, and easternmost islets of Yap State. Mixed broadleaf forests comprise the dominant vegetation type on the high volcanic islands. Historically, broadleaf forests almost completely covered these high islands, but people have since cleared or disturbed much of the lowland vegetation. A recent aerial survey of Pohnpei Island found two-thirds of the native forest to have been lost in the past twenty years (**Figure 4**). Lowland vegetation on the high volcanic islands is dominated by mangrove and swamp forests, though large portions of these forests are being disturbed by human activities. Healthy examples of these forests still exist, though, along isolated coasts of Pohnpei and Kosrae. Located at just 450 meters on Pohnpei and Kosrae, montane cloud forests thrive on the unique combination of relatively high rainfall and elevation. These cloud forests are a global rarity, as they are some of the lowest elevation cloud forests in the world and are home to over 30 species of tree snails, 24 species of birds, and three species of endemic flying foxes (Raynor 1993). Endemism is very high in this ecoregion, a result of a unique combination of distance and isolation. Plants and animals from the biologically

diverse Southeast Asia mainland, although located thousands of iles to the west, were able to island hop through the Caroline Island archipelago, since the greatest distance between any island from Palau to the Marshall Islands is only 200-300 miles. As a result, over 200 endemic species inhabit the Carolines Tropical Moist Forest Ecoregion. Pohnpei Island, in particular, contains a high number of endemic species from its unique combination of size, soils, climate, geology, and topography in addition to being the highest geographic point for more than 2000 miles in any direction creating a geography not found anywhere else in the world (Raynor 1993). The list of endemic species for this ecoregion includes four endemics with at least one endemic genus of over twenty-four species of native reptiles (Dahl 1980) and four flying foxes (*P. molosinnus, P. insularis, P. phaeocephalus, P. mariannus alnus*). Thirteen birds are endemic to the ecoregion, including the Truk monarch (Metabolus rugensis), the Pohnpei fantail (Rhipidura kubaryi), the Pohnpei mountain starling (Aplonis pelzeni), and the Pohnpei lory (Trichoglossus rubiginosus). On the island of Tol in Chuuk, one of the world's most endangered rainforests survives precariously on the peak of Mt. Winipot (and other small mountaintops in the Chuuk lagoon). The islands of FSM exhibit a great diversity of marine ecosystems, from high volcanic islands with fringing and barrier reefs to coral atolls, including Chuuk lagoon, one of the world's largest (823 mi2/3130 km2) and deepest (60m/200ft) (TNC 2003)[21].

FIGURE 4: Change in Native Forest Cover on Pohnpei, by year



Source: Conservation Society of Pohnpei

These diverse habitats and species have always had a profound influence on the Micronesian people and their cultures[22]. There are marked ecosystem and thereby cultural differences among and even within the four states, reflecting both the conditions of nature and the social structures that have evolved over the thousands of years since the islands were first settled. In both the communal subsistence and cash economies, the land and marine resources that constitute the natural environment of the FSM are essential to the physical and cultural life of the people (CCNC 1997.)

[21] Reefs are supremely valuable in terms of the ecosystem services that they provide. According to the 2002 National Coral Reef Action Strategy (NOAA), "Reefs support more species per unit area that any other marine ecosystem. In many ways, coral reefs rival and surpass tropical rainforests in their biological diversity and complexity."

[22] This cultural diversity is reflected in the existence of seventeen indigenous languages: Yapese, Ulithian, Woleaian, Satawalese, Pohnpeian, Nukuoran, Kapingamarangi, Mokilese, Pingelapese, Ngatikese, Namonuito, Nguluwan, Paafang, Puluwatese, Chuukese, Mortlockese, and Kosraean (FSM NARSDS 2006, Balick et al. 2009).

1.2.4 Topography and hydrology

The biota of the FSM has also been influenced by the volcanic activity that created the islands and atolls of the FSM (TNC, 2002), resulting in the mountains that exist on the larger high islands, going from east to west in the Caroline Island Group. Geologically, Kosrae in the east is the youngest island, and the islands gradually become older as they move toward the western end of the Caroline island chain (USDA SCS 1982). These islands range from islets barely above sea level – the majority of the islands - to the high islands – of which Pohnpei, which reaches 791 meters above sea level (Nahnalaud), and then Kosrae (Mt. Finkol at 635 meters) and Chuuk (Mt. Uinipot on Tol Island at 443 meters) follow, in order (UNCCD, TNC 2002). On the High Islands of the FSM, these forested mountains, or uplands, are quite important to the functioning ecologies, as they account for 63 percent of the total land area in Kosrae, 56 percent in Pohnpei, and 33 percent in Yap[23], and with about 10 percent total in Chuuk (USFS 2003). The unique forests of the high islands protect watersheds and prevent erosion. The substantial, often swampy lowlands on these islands include coastal mangrove, swamp, and marsh areas that then filter run-off sediments and act as nurseries for many marine species (CCNC 1997) that thrive on the nutrients contained within the freshwater. Importantly hydrologically, Kosrae and Pohnpei have perennial streamflow[24]; the large deltas of rivers with short stream length and steep channel gradient attest to the very high rainfall which occurs in the mountainous interiors of these islands (CCNC 1997) and serve collectively as an invaluable, nearly infinite resource for the region, as most of the water that does not run-off is absorbed through the soils and rock and sits in huge underground fresh water lenses in basalt caves created by earlier lava flows and geologic formations (Scheidt 2009, pers. comm.).

FIGURE 5: Kosrae Montane Cloud Forests

Source: Equator Magazine, 2006

Source: USDA 1982

1.2.5 Climate

FSM has a tropical climate that varies with seasonality of rainfall, influenced by the two distinct ecoregions noted above. The climate is tropical marine with daily temperatures ranging from about 24 C (mid 70's F) to 29 C (mid 80's F) with little average variation throughout the year. Rainfall is plentiful

[23] It should be added that the highest point on Yap (Mt. Matade) is about 175 meters above sea level (WWF 2009). Although it cannot be characterized as having mountains, it does have peaks and valleys that support watershed and riparian forests.

[24] Kosrae and Pohnpei each have hundreds of small streams and a multitude of larger rivers, many of which, under normal weather conditions, flow year-round.

and ranges from 304cm (120 inches) per year for drier islands like Yap, and over 1,016 cm (400 inches) per year in the high mountains of Pohnpei and Kosrae (UNCCD 2002)[25]. Humidity averages over 80 per cent. Northeast trade winds prevail from about November to May when conditions may be drier on western islands of the FSM. The region is affected by storms and typhoons which are generally more severe in the western islands, and by periods of drought and excessive rainfall associated with the "El Nino" (ENSO) phenomena. In recent times, the droughts of 1982-1983 and 1997-1998 were especially severe (UNCCD 2002).

1.2.6 Culture


photo by Asen Mafrinov

Cultural diversity and ecological diversity are inextricably linked. In a world rocked by global change, traditional knowledge and practice has an important role in maintaining a healthy environment and people (Balick et al. 2009). Thus it is that cultural features too have served to fashion and maintain the FSM's unique biodiversity. The conservation of forests, watersheds and fauna were deeply ingrained in the culture of pre-contact FSM (Falanruw 2002) , and such cultural practices, though diminishing through development pressures and globalization, are still quite relevant today (Wortel 2004)[26]. The same factors that led to high biological diversity in Micronesia also led to high cultural diversity. Seventeen local languages and numerous cultures exist over the 1,800-mile archipelago. The FSM's human population is approximately 107,000 (FSM 2000c), with most people living on the high volcanic island district centers of the four main island groups of Kosrae, Pohnpei, Chuuk, and Yap. During the 1980's, the population growth rate was three percent per year, one of the highest population growth rates in the world. Since 1996, emigration to the U.S. and its territories (through provisions in the Compact of Free Association) has slowed population growth to just .3 percent annually (FSM 2002c, TNC Blueprint 2002), a trend that has likely commensurately reduced pressure upon local resources. Interestingly, the population on some islands may have been higher during the nineteenth century than it is today. On Pohnpei, for example, the population in 1820 was estimated at 15,000 (Ashby 1993), yet traditional cultures were able sustain the biological resources of the island through careful use (TNC 2003). The pre-contact population of Yap has been variously estimated at 273-530 people per sq. kilometer (709 1,378 people / sq. mile) (Falanruw 1995). While there are limits to an island's carrying capacity, and while the context for many traditional practices is no longer present, the precedent of traditional management and the practice of some ecologically based technologies provide a framework

[25] Oceanic currents as well as the Cloud Forests of the FSM's high islands, which create their own weather systems, combine to make Kosrae and Pohnpei two of the most precipitous places on Earth.

[26] From An Assessment of National Capacity to Address In-situ Conservation and Initial Assessment and Monitoring, including Taxonomy. National Biodiversity Strategic Action Plan Project – Phase II. FSM Department of Economic Affairs, 2004, pp. 18-22.

for incorporating modern science into an island-relevant system of resource stewardship (TNC 2003). Tenure over land and marine areas varies island to island and state to state, but the majority of the nation's land and inshore marine areas are privately or collectively owned. The nation's people depend heavily on the natural environment for their survival as evidenced by the fact that median annual household income in 2000 was only US$4,618 (FSM 2002c). As yet, tremendous pressure for economic growth and changing cultural practices, combined with population growth and changing demography in the FSM threaten biological resources (TNC 2003). Conventional western approaches to conservation - government management and enforcement of large-scale conservation areas - have been ineffective due to land and marine ownership patterns, the difficulties inherent to regulating activities in extremely remote locations, and the limited capacity of government natural resource agencies (FSM 2002; SPREP 1993; Micronesian Seminar 2002). And still, there is one overriding cultural facet of the FSM that persists: respect. What is lacking in most of all industrial societies – a sense of community – is omnipresent throughout the FSM. The great leveler is the role that community plays in fostering respect, including self-respect, which ultimately promotes respect for the environment (Balick 2009).

1.2.7 Biomes and constituent ecosystems of FSM

Biomes and their constituent ecosystems can be generally placed into two overall categories: terrestrial and marine. Each of the ecosystem types, which can also be referred to as natural communities or ecological zones, will be discussed in more detail in the section below as it relates to the current overall status and trends of each. Briefly, there are generally twelve closely interconnected and naturally occurring terrestrial ecological zones in the FSM (TNC 2003, CCNC 1997), and they are the atoll forest/littoral beach strand, mangrove forest, swamp forest, freshwater marsh, riparian forest, freshwater rivers and streams, grassland (savanna or fern lands), secondary (agro) forest, primary (including palm) forest, rain (native upland and lowland mixed broadleaf) forest (Falanruw 2002), and crest (dwarf or montane cloud) forest. This biome stretches from the high tide level to the tops of the highest mountains (CCD 2002) [27]. The major marine ecological zones are the mangrove forest, estuaries, sea grass beds, lagoons and coral reefs. The mangrove forest provides the key transition and therefore is mentioned in both ranges; it is the crux of a functioning and healthy island ecology, as this ecosystem serves as the mediator between the marine and terrestrial environments[28].

> ***FSM's rainforest biome***
>
> *FSM*'s Carolines Tropical Moist Forest Ecoregion, spreading from the easternmost islets of Yap State all the way to the high island of Kosrae, spread over about 2,700 km, contains a healthy variety of representatives of the world's rainforest biome. Endemic species are found across these tropical forested regions of the country. As a result of environmental conditions, FSM'a rainforests are of two distinct elements: the lowland rainforests and the montane and submontane rainforests. The respective complement of fauna and flora as well as the natural forest formations of these two groups show distinct differences (CCNC 1997).

[27] In conservation jargon, this necessary way of viewing the interconnectedness of ecologicl geography is referred to as 'Ridge to Reef'.

[28] On the high islands of the FSM, these various ecosystems are in relatively close proximity to one another – e.g. Kosrae – as one travels from the reef to the interior, and as such, if one is observant, it is easy to see the interplay and connectedness between the different zones, and in particular, how the different species habituate and move between them.

1.3 Status and trends of FSM biodiversity

The status of FSM biodiversity is both spectacular and extremely fragile. It is influenced by both natural and anthropogenic features, and has a multitude of unique and biologically notable terrestrial, coastal and marine, inland wetland, riparian and agricultural ecosystems (**Table 1**). Forests are a predominant vegetation type on the islands, and contain a wide variety of species. They range from lowland, premontane and montane rain forests, moist evergreen forests, to dwarf or cloud forests of the tropical moist forest ecoregion, and the predominant dry mixed broadleaf forests, mangrove forests and savannas of the tropical dry forest ecoregion.

TABLE 1: Land Balance Sheet for FSM (high islands only)[29]

Type of land	Hectares (ha)
Reserved land (reservoirs, streams, roads etc.)	1,305
Mangroves and Marsh	9,112
Swamp forests	1,014
Upland forests	20,871
Palm forests	1,383
Agroforests	19,366
Secondary vegetation	4,020
Grasslands	3,825
Total land area	**70,896**

Source: adapted from Whitesell et al. 1986, MacLean et al. 1987, and Falanruw et al. 1987a&b)

Both of these ecoregions include significant atoll forests across the range, with extensive riverine forest ecosystems represented most greatly by the isolated high island environments of Pohnpei and Kosrae (CSP, 2006). **Table 2** below shows some of the ecosystem diversity within the FSM. There are also several types of grasslands distributed in the wet and dry areas, at both low to high elevations (Falanruw 2002). FSM also has ample inland wetlands from hundreds of waterfalls, streams and rivers that originate from the mountains, fed by high annual rainfall and continuous upward protrusion of underground water stored in aquifers. Together they provide habitats for a unique freshwater wetland fauna and flora. Composed of many islands, FSM is also surrounded by a multitude of marine and coastal

[29] In Chuuk, only the high islands of Moen, Dublon, Fefan and Eten are included, thus the numbers are likely greater overall. More work needs to be completed in this area (aereal photography and GIS mapping) to get a complete glimpse of lands in FSM, especially for the Atoll islands (Falanruw, 2002).

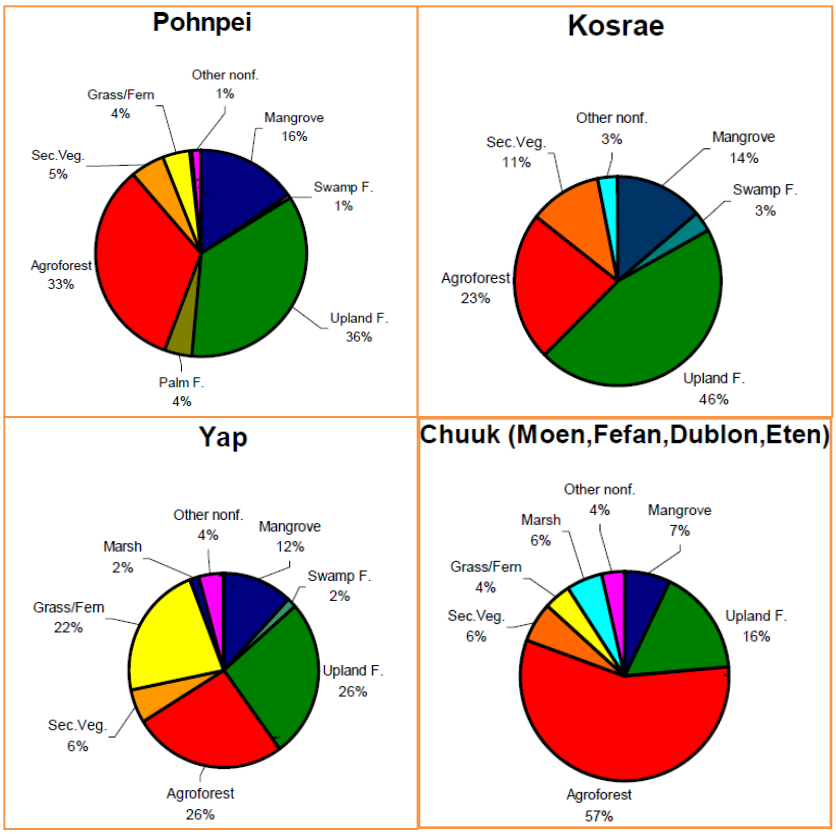
ecosystems along its coastline, featuring several types of reefs, many channel passes, coral gardens and blue holes, bays and lagoons, wide sandy beaches, extensive seagrass meadows, mangrove habitats and coastal marshes (CSP 2006). Furthermore, considerable biodiversity exists in human modified areas such as village home gardens, as well as in the extensive agroforests, and even in built-up areas such as roadsides and urban environments. **Table 3** provides percentages for the main types of terrestrial environments in each state jurisdiction of the federation.

TABLE 2: Ecosystem Diversity of FSM

Ecosystems	Provisional extent (ha)
Forest and related ecosystems	
• tropical wet lowland broadleaf forest (lowland rain forest)[+]	na
• tropical upland broadleaf rain forest[+]	na
• riparian forest[+]	na
• tropical montane and sub-montane forest	na
• cloud or dwarf forest	na
• atoll forest	na
• grasslands (fern sedge savannah)	na
Inland wetland ecosystems	
• flood plains/valleys	na
• swamp forests	na
• streams and rivers	na
• aquifers	na
• coastal freshwater marsh	na
Coastal and marine ecosystems	
• mangrove habitats[+]	na
• salt marshes[+]	na
• beaches[+]	na
• seagrass beds	na
• lagoons and basin estuaries	na
• coral reefs	na
• coastal seas	na
Agricultural ecosystems	
• small crop holdings or other field crops (citrus, pepper, sakau, etc.)	na
• vegetables (including, root and tuber crops)[++]	na
• crop plantations (coconut)	na
• home gardens (cultivated)[+]	na

Not surprisingly, a high ecosystem diversity in the islands of FSM has also given rise to a wide range of indigenous species among which are many climatic and edaphic variants, particularly among the plants (Glassman 1952, Fosberg et al. 1987, Falanruw 2002, Balick 2009), indicating the existence of a relatively high genetic diversity. Furthermore, the various geo-evolutionary and geological processes in FSM, coupled with large spatial variations in climate and topography, have promoted isolation of species resulting in a large number of geographically relict species not found anywhere else in the world (TNC 2003, Balick 2009). In general, the mountain, riparian, coastal and reef ecosystems harbor a wonderful and useful mix of species, nearly all essential to the dialy lives of the people, most particularly those in the more isolated and rural areas, which are the majority (FSM 2000c). These include the forest pigeons and fruit bats, the river eels, freshwater prawns and river snails, rabbit, mullet and trevally fish, and the coral groupers, sea turtles and reef sharks that inhabit them.

TABLE 3: Major vegetation types of high islands of FSM



Source: Terrestrial Biodiversity of the Federated States of Micronesia, Falanruw, 2002

Yet it is this very geographic isolation, precise ecological uniqueness, and species richness and abundance that also provides for an overall trend of extreme fragility and of the potential loss of biodiversity, particulary amongst the indiginous ecosystems and species of the FSM. Thus the increasing trend for the loss of populations of species due to habitat loss, degradation and fragmentation, is

expected to have adverse effects on the genetic diversity of populations - among both the fauna and flora - in the long-term (CCNC, 1997). The status and trends of FSM's ecosystems and species biodiversity is discussed in more detail within this section below.

Keystone Species

Native mammals of the FSM include five species and subspecies of fruit bats of the genus *Pteropus* and a sheath-tailed bat [*Emballonura semicaudata]*. Taxonomic studies of the fruit bats are not complete, but all are presently considered endemic species and subspecies. The *Pteropus* fruit bats (or flying foxes) are considered to be the premiere keystone species essential to the long-term survival of forests as they serve to pollinate and disperse seeds of forest species (Falanruw 2002) and maintain apex functionioning of the upland and montane cloud forests in Kosrae, Pohnpei, Chuuk and Yap. Although they are not eaten within the FSM – unlike in Saipan and Guam, where the Chammoro people regard them as a delicacy and will pay high prices – they are nonetheless threatened due to habitat loss from climate change and clearing of forest for agriculture and other development, as well as poaching for export. Worldwide, fruitbats are covered and/or protected under CITES and the US Endangered Species Act. In the FSM, several are listed on the IUCN Red List, which generally means a species is on a path toward extinction unless measures are taken to abate their decline. A keystone species is regarded as a primary indicator of overall biodiversity health.

Kosrae Fruit bats relax at the small coral island of Yen Yen, one of a handful of known colonies on the island.

As for the Pacific or, Caroline (Falanruw 2002) sheath-tailed bat (Emballonura semicaudata), they are more rare and less well known in the FSM. Although they were once widespread and common in Polynesia and Micronesia, their numbers have declined significantly. The species has gone extinct in Guam, Anatahan, Dublon (Chuuk Lagoon island), and Viti Levu. In the FSM it is now only found on Moen (Weno), Pohnpei, and Tol, and listed as endangered by IUCN (2006 IUCN Red List of Threatened Species.) The bat is small, ranging from 41-48 mm, and has limited ecological data available simply because it has been very little studied. Its faborite habitat is intact native forest and small colonies roost on the lower truncks of trees, under the cover of large branches (O.L. Wortel, pers. obsv.), which protects them from strong winds. Because of the Pacific sheath-tail bats' dependence on native forest for food, the persistence of a population is threatened by deforestation, especially on small islands. Without forest protection, the bats are easily blown away from their foraging habitat (and food) by strong winds. Slow reproductive rates combined with the threats of feral cats, deforestation and increased disturbance to add to the risk of extinction of these distinctive bats. The Pacific sheath-tail bat is the only insectivorous bat that is widely distributed in Polynesia and Micronesia. In addition to their cultural significance, insectivorous bats such as the Pacific sheath-tail bat play an important role in maintaining forest populations of flying insects. Palau and Fiji have the most numerous populations of this species (Palmeirim *et al.* (2007).

1.3.1 Forests and grasslands

It cannot be overstated how important the forests and other terrestrial ecosystems are to the overall health of coastal and marine and reef environments of the FSM. Although the total native forested area

is relatively small – about 600 km^2 (CCNC 1997) - in comparison to the rather vast marine biomes of the FSM, the ability of the forests to function at or near climax levels is supremely vital to the overall health and productivity of reefs and sea grass bed ecosystems in particular (CSP 2006). More specifically, these marine environments include the integrated communities of coastal marine depressions, bays, seagrass meadows, lagoonal holes and channels, coral beds and thickets, sand flats, reef flat and crest and outer reef slopes (TNC 2003), and they shelter and provide food for the millions of pounds of (CSP 2006, YapCAP 2007) smaller mangrove and reef-based and palaegic fishes that in turn feed and populate the world's oceans. On this count, these forests once again show that they are not only vitally important locally, but also globally. The islands of the FSM, scattered as they are over a core part of the Pacific Ocean, are literal hubs of diversity that ultimately project a far greater ecological influence than their size initially suggests. Many of the special forest types in the FSM have been identified as conservation targets (**Table 4**) and efforts are ongoing to protect them from ongoing encroachment and development (TNC 2003).

Since the 1970s, several important initiatives have been carried out in FSM to assess the extent and status of the country's forestry resource. At the beginning of the last century FSM had more than 70% of land area under natural forest cover (Falanruw, Whitesell et al., 1987)[30]. Forest surveys based on aerial imagery carried out in 1995 and 2002 by the FSM Department of Resources and Development, The Nature Conservancy and the United States Department of Agriculture showed, however, that close canopy natural watershed forests in Pohnpei (i.e. with over 70 per cent crown closure) had dropped by then to 12% of the total land area. This amounted to a decline of 67% of the native watershed forest in the past twenty years (TNC, USDA USFS 2002). Lowland vegetation on the high volcanic islands is dominated by mangrove and swamp forests, though large portions of these forests are also being disturbed by human activities. Healthy examples of these forests still exist, though, along isolated coasts of Pohnpei and Kosrae (TNC 2003). An ongoing State-Wide Forest Resource Assessment and Forest Resource Strategy[31] seeks to get a more updated and comprehensive analysis of current status and trends in overall native forest cover throughout the FSM.

Vegetation maps from 1976 aerial photos indicate that wild forests cover about 40% of the land area of Yap, including mixed broadleaf forest, swamp, and mangrove (Falanruw, Whitesell et. al 1987). Agroforests (tree gardens) cover another 26% of the land area, and about 22% of the vegetation is savanna. Scientists believe that prior to human habitation, broadleaf deciduous forests covered most islands within this ecoregion. However, the introduction of human-induced wildfires within the Western

[30] The FSM high islands were probably almost completely forested at one time, with a few patches of savanna (WWF 2009).

[31] The goal is to ensure that federal and state resources are being focused on important landscape areas with the greatest opportunity to address management priorities through qualitative, quantitative and geospatial data amid a comprehensive analysis of forest-related conditions, trends, threats, and opportunities within the state, with a delineation of priority forest landscape areas. The process is to be completed by June 2009.

Caroline Islands, a region naturally prone to frequent droughts, has resulted in extensive grasslands and savannas in Yap in particular (TNC 2003). As is currently clear from the previous statement, vegetation maps for the FSM are largely outdated (TNC 2003). Most terrestrial occurrences were mapped from vegetation data derived from twenty year-old aerial photographs produced by the Trust Territory Government and the US Forest Service. As such, the FSM desperately needs updated vegetation maps in order to more effectively gauge what the status and trends for forests are across the islands.

In terms of these information gaps, nationally the FSM is completed the first phase of an FSM-Protected Area Network GAP analysis of the exiting national Protected Areas using GIS technology and cross coordination of various programs ongoing, including the PIMPAC Strategic Action Plan process, the SEM-Pasifika Initiative, the Locally Managed Marine Areas network, the RARE program and the internationally renowned Micronesia Challenge[32]. The ecological gap analysis seeks to link these similar exercises being undertaken both nationally and regionally toward the compilation into a comprehensive national report (FSM 2008) for politcal endorsement and action by the end of 2010. In this vein as well, a historical conservation initiative was undertaken in 2002 that identified more than 130 sites termed Areas of Biodiversity Significance (ABS), of which 23 are strictly terrestrial related, mainly upland native forests (TNC 2003)[33]. All of the ABS are considered important to the long-term conservation of biodiversity in the FSM and to further justify ongoing conservation actions (TNC 2003).

The ABS review was a major biodiversity assessment of the islands and identified natural upland forests in need of long term protection in excess of over 22,648 ha. This does not include other identified forests considered ABS, such as mangroves, lowland rain/broadleaf forest - considered some of the least well-known and threatened forests types in the islands (TNC 2003) – palm forests, fresh water swamps and atoll forests. A cursory review of the ABS assessment reveals that wet lowland rainforests as some of the richest among FSM's forests in terms of biodiversity and endemism (TNC 2003), and of prime importance for soil and water conservation (IUCN 1997, USDA 1982). These also include riparian forests, which is a broadleaf evergreen forest on moist soil, adjacent to streams, also often richer in species than forests on drier upper slopes. These extremely fragmented wet lowland forests are also the last remnants of the once widespread tropical rain forests of FSM, which have been heavily impacted by extensive human modification (TNC 2003). In terms of evolutionary importance among endemic species, however, the forests of the higher montane zone are the main habitats for much of the endemic faunal elements in the islands, due to mountain top isolation and least disturbance by biotic invasions (Fosberg

[32] The ground-breaking Micronesia Challenge seeks to conserve under protection at least 30% of the near-shore marine environments and 20% of forests throughout the Federation by 2020. It will be addressed in more detail in Chapter 2.

[33] The outcome of the comprehensive biodiversity assessment is the seminal, Blueprint for Conserving the Biodiveristy of the Federated States of Micronesia, and should be read by anyone interested in the field of conservation. This document will be discussed further in Chapter 2.

1996)[34]. This type of forest is also rapidly broken down by the trampling, rooting or browsing of large animals, as it originated in the absence of such animals, and the component trees are not able to withstand these disturbances. Trails in this forest become canals of mud after very little use (TNC 2003).

Diversity of the Tropical Forests in FSM

For relatively small island biomes, the FSM exhibits a marked diversity of forest types as a result of the differences in spatial distribution of rainfall, altitude and soil. From above 300 m, the montane forest changes to dwarf cloud forest (Fosberg 1996), where trees are stunted (typically 10-20 feet, sometimes more). On Kosrae the vegetation is dominated by a scattered layer of trees (*Elaeocarpus caroliniensis*, *Cyathea* spp., and *Astronidium kusaianum*) and ferns - *Nephrolepis*, *Gleichenia linearis*, *Davallia*, *Lycopodium* and other genera. On the highest, wind-blown summits of Pohnpei, trees reach only 4-5 feet in height. The canopy height of the rain forests show a progressive decline, as wet lowland forests occurring at heights of just above sea level to 100 m quickly transform into sub- montane forests and mixed broad leaf forest at around 100 - 200 m, and again into montane forests at elevations above 200 m, where species diversity is high (Fosberg 1996). The lowland forest

zone contains yet another distinct group of vegetation termed low-elevation broadleaf forest (Glasman 1952). Due to extensive human modification of the islands' lowlands, only a few remnants of this forest type remain (TNC 2003). Within and bewtween the sub-montane and lowland forests, what are referred to as riparian forests also exist. This is a broadleaf evergreen forest on moist soil, adjacent to streams, often richer in species than forests on drier upper slopes.
Often merges with upland broadleaf forest above, and swamp forest and mangrove on lower coastal bottomlands. The species composition varies between high islands. Trees are often larger than surrounding forest and ferns and epiphytes are common (TNC 2003). The riverine species *Samadera indica*, previously known only from Palau in Micronesia has recently been found in Yap. The lower forests, generally at 0 -10 m, have the characteristic tropical equatorial forest that further the popular notion of tropical vegetation in the Pacific (Balick wt al. 2009), with an overall canopy height that is less than 20 m and is relatively open compared with the higher, wetter forests of the FSM. For atolls however, they have an uncharacteristically diverse flora, probably because of the relatively heavy rainfall, dominated with vegetation that consists of pan-tropical lowland strand species (Fosberg 1996) that are economically and socially important. (Balick et al. 2009) – e.g. breadfruit, pandanaus and coconut amongst them.

[34] The central high mountain forests that exist largely in the clouds harbor endemic tree snails, mountain starlings, flying foxes and sheath-tailed bats.

From 1919 – 1944, during the Japanese occupation of the FSM, wet zone forests – particularly the swamp forests dominated by the Terminalia carolinensis trees, which had long, straight, branchless trunks and grew up to 35 m – were heavily logged and milled for lumber (Hezel 1998). This, along with the conversion of these swamp lands to taro patches and, as these forests sit in the flood plains and valleys of the high islands, and therefore comprise the flattest terrain, for increased development of homes, government buildings and industrial development. Consequently, much of the remaining wet zone forests have also been selectively logged. This trend continues today, with the state, national and international governments pushing for a road through the last freshwater swamp forest of its kind in the world – let alone the FSM – leaving the Yela *Ka* forest of Kosrae under serious threat. Nearly all of these forests in the FSM are either completey gone or are now severely fragmented and surrounded by a high human population density, so that their potential regeneration is nearly impossible. Cutting of the endemic *Terminalia carolinensis* trees (they are found only in Pohnpei and Kosrae) is still practiced, particularly in Kosrae, where the trees are the preferred wood used by master canoe builders on the island. As such, the numbers of trees, and the quality (as the tallest, straightest and biggest trees are cut year after year) continue to decline where the last relatively intact stands exist (Wortel 2005)[35].

However, slowly the conservation value of wet zone forests as the only refuge of some of the rarest faunal and floral species in the world is now becoming recognized, and there is a positive move by governments and NGOs to not only engage local communities, but also vice versa, for local families that want to protect their lands for the public interest to engage local governments and international conservation NGOs to halt anthropogenic disturbance to forests in all climatic zones.

In recent years forests have been given greater attention in terms of their ecologic importance and intrinsic value of the provision of services and the support of the local economic base for communities. In kosrae, watersheds and upland forests are now being looked at by policy makers and owners of land as areas to be protected for the common good (KSL, KCSO 2008). A family of landowners in the Yela valley seeks to (YELA 2006) save the last remaining *Terminalia carolinensis* forest in the world, a fresh water swamp as majestic as the Redwoods of North America[36] (Wortel 2004). In Pohnpei, since the mid-1980s, the state has protected all of its mangrove forests and 51 km^2 of its interior forests as a watershed reserve (WWF 2009). Although enforcement and the regulatory environment surrounding such conservation efforts are still ongoing (CSP 2004), these initiatives set valuable precedents for the federation. In Yap, the Dalipebinaw School Forest Reserve – the first of its kind in the nation – protects several types of forest, including lowland mixed broadleaf forest, and one of only two currently priority-identified riparian forests in the FSM. Dalipebinaw is home to several threatened and critically

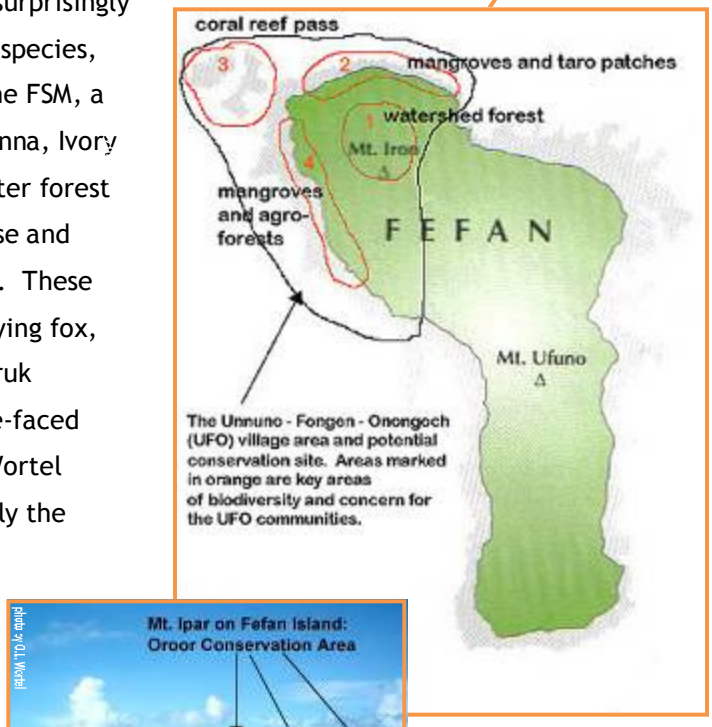
[35] Wortel, O.L., 2005. "The World's Last Ka Forest: Will it be Saved?" The Micronesian Alliance, vol. 1, issue 14; and, "Micronesian Carver in Action", the Micronesian Alliance, vol. 1, issue 13.

[36] As coined by Senator Noah Idechong of Palau, one of the pioneers of the modern conservation movement in the Micronesian sub-region, upon seeing them for the first time in 2004.

endangered species, including the Yap Cicabird, the Micronesian Pigeon, the White-throated ground dove, the Yap flying fox and the Yap monarch. Indeed, many, if not all, of the ABS forests identified throughout the FSM are within ecological systems (TNC 2003) that continue to support the greatest remaining species biodiversity.

An excellent example is the Oroor Forest Reserve along the northeastern front of Fefan Island, one of the high lagoon islands in Chuuk (Wortel 2004). Oroor is the second largest native upland forest in Chuuk (Chuuk EPA, 2004) and is amongst the top 24 priority action areas for protection in the FSM, as it is one of the largest intact and most biologically important biomes remaining in Micronesia (TNC 2003). Interestingly, Oroor has been conserved for generations due to chiefly decrees and cultural taboos and beliefs related to the area, which themselves are heavily conservationist in scope (Wortel 2004). Oroor, a surprisingly small but stunning assemblage of ecosystems and species, typifies the compact high islands ecosystems of the FSM, a biome of Mixed Broadleaf forest, Fern-Sedge savanna, Ivory Nut Palm forest, Riparian forest, Coastal Freshwater forest and Mangroves containing some of the most diverse and threatened endemic flora and fauna in the nation. These include the Caroline Island ground dove, Chuuk flying fox, Chuuk poison tree, Truk greater white-eye, the Truk flycatcher, the Nightingale reed warbler, the Blue-faced parrot finch and the Chuuk monarch (TNC 2003, Wortel 2004). Chuuk's remnant native forests, particularly the Chuuk broadleaf native forest, are limited to a few ridges on four of the lagoon islands and are by far the most endangered ecological system that have been identified by the nation's ecoregional plan. There is at this time a continuing and urgent need for rapid fieldwork to assess the extent and viability of these remnant patches (TNC 2003).

FIGURE 6:
Oroor Forest Reserve in Chuuk



Source: Seacology 2004

In more detail below is a look at each of the main terrestrial ecosystems found within the FSM, their status and trends.

TABLE 4: Some Targeted Conservation Areas Identified by Forest/Grassland Type in FSM

Forest or Grassland type	Area of Biological Significance (ABS) [37] (by State)	Total forest area (ha)
Atoll Forest - Beach Strand Complex	Chuuk – Kosrae – Pohnnpei - Yap	30,560.3
Fern-Sedge Savanna	Chuuk - Kosrae - Pohnpei	225
Limestone Forest	Yap	42.1
Montane Cloud Forest	Kosrae - Pohnpei	10,590
Riparian Forest	Yap	117.4
Swamp Forest	Pohnpei	2,787.7
Mixed Broadleaf Forest	Chuuk – Kosrae – Pohnpei - Yap	5,981.8
Atoll Inland Mangrove Forest	Chuuk - Yap	4,073.7
Clinostigma Palm Forest	Chuuk - Pohnpei	532.9
Ivory Nut Palm Forest	Chuuk - Pohnpei	418.5
Terminalia/Nypa Swamp Forest	Kosrae	934.2
Mangrove Forest	Chuuk – Kosrae – Pohnpei - Yap	10,386.3
Montane Perched Freshwater Marsh	Pohnpei	32.3
Coastal Freshwater Marsh	Chuuk – Kosrae – Pohnpei - Yap	1,133.9
Total Priority Areas Identified		**67,815.4***

Source: A Blueprint for Biodiversity Conservation, The Nature Conservancy, 2003.

**The total reflects all terrestrial ABS identified, as well as inlcusion of areas of coastal marine sites connecting terrestrial and coastal targets.*

Cloud Forests

Cloud, crest, or dwarf forests are found on top of the peaks of some of the mountains of the FSM. Other common names for these forests growing at over 615 m (ca. 2,020 ft) are moss forest or elfin forest, referring to the epiphytes, ferns, and mosses that are found on the stems and branches of the trees in this habitat, where plants rarely grow to exceed 6 m (20 ft) in height. Trees such as *Elaeocarpus carolinensis* and *Astronidium ponapense* are characteristic of this zone, as well as the ferns *Lycopodiella*

[37] Terrestrial sites, mainly upland native forests, make up just 8% (87.4 sq. mi.) of total ABS area, but total 23 sites. This reflects the relatively limited extent of natural terrestrial systems on small Pacific islands compared with the much larger marine systems surrounding them (TNC 2003).

cernua, *Asplenium nidus L.*, and *Sphaeropteris nigricans* (Mett.) R.M. Tryon (Balick et al. 2009). The dense and dwarfed vegetation of the unusual crest forest is found only on the extremely wet mountain ridge summits of Kosrae and Pohnpei. Many of the plants are dwarfed specimens of species found at lower elevations (CCNC, 1997). These dwarf moist forests of stunted trees covered with mosses, ferns, fern allies and orchids, are generally shrouded in clouds (Falanruw 2002) and in these special sites, water from dense fog and copious rainfall provide an extremely wet and humid environment for the plants. Most of the species found in these special areas are native and many are endemic. Cloud forests are truly one of the most special habitats in the FSM (Falanruw, 2002). Indeed, Pohnpei boasts the world's lowest dwarf cloud forest at 450 m elevation. These cloud forests are a global rarity, as they are some of the lowest elevation cloud forests in the world and are home to over 30 species of tree snails, 24 species of birds, and three species of endemic flying foxes (Raynor 1993). They are extremely fragile environments and represent the top of the watersheds that sustain the climax function of the varied ecosystems on Pohnpei and Kosrae, the two highest islands within the entire Caroline Island Archepelago. The cloud forests also help dictate overall weather conditions in these islands by creating and trapping moisture-filled clouds. These are extremely unique areas and in need of protection.

The Forest

photo by O.L. Worte

Forests are the "lungs of the earth." They respire oxygen and inhale carbon dioxide; they also build soil, absorb moisture and translate sunlight into biomass more efficiently than any other ecosystem on earth. From their roots deep in the ground trees bring up both water and minerals. Transpiration humidifies the air, moderates extremes of temperature, and creates complex micro-climates, as well as rich habitat for many life forms. The minerals come to rest in the tree's body, which will one day become topsoil. One of the great benefits of forests is to moderate hard rains so that the water soaks into the soil and subsoil. Rain soaks into the forest and feeds the streams and aquifers – so vitally important to the functioning of the high island ecologies of the FSM and its people – with little mineral content and few suspended solids. In this way a forest supports the adjacent aquatic ecology. It is the quality of water that drains from the forest which is important. In FSM today, whole communities – thousands of people – rely upon untreated water from the watershed for drinking and bathing on a daily basis. The quality of the water has a direct correlation to their continued quality of life.

Source: WM. H. Kotke, 1993.

Native Upland (Primary) Forests

The Japanese botanist Hosokawa wrote about the *Campnosperma* forests of Micronesia, as *Campnosperma brevipetiolata* is one tree that is common throughout most of the forests of Micronesia. More recent studies have shown that the *Campnosperma* trees of eastern Micronesia are somewhat different from those of western Micronesia (Falanruw, 2002). The use of the term primary forest is restricted to that area of the FSM's high islands excluding Mangrove, Swamp, Secondary, Rain, and Crest Forests. It is a forest containing primary vegetation comprising native species. The forest grows on

substrate from weathered volcaninc rock, and it is a highly threatened ecosystem (Balick et al. 2009). Extremely little of this ecosystem remains in Chuuk[38] and Yap, but extensive areas are still found in Pohnpei and Kosrae. Endemism is high (WWF 2009). Characteristic vegetation includes banyan figs, pandanus, climbing screwpine, the endemic palm (*Clinostigma ponapensis*) and a range of hardwood tree species[39]. This zone provides for a wide range of human needs including timber, fruit, nuts, medicines, handicrafts, and dyes (CCNC, 1997). The trees in these forests are generally very large, ancient, and resplendent with vines and mosses, and they are oftern surrounded by palms and fern trees and intersected by pools of water, streams and rivers. There are butresses supporting some tree species, and the habitat is reminiscent of tropical forests elsewhere around the world (Balick et al. 2009). These upland forests of the FSM vary from east to west, and, on the higher islands of Pohnpei and Kosrae especially, they vary with elevation up the steep mountains. As yet there still need to be studies undertaken to define exactly the types of native forests that occur, everywhere they occur, as well as the extant across the federation. These forests are heavily used and depended upon for a host of practical uses, not to mention the vast ecological services that they provide, in terms of the provision of key habitat, soil retention, and river and stream flow and integrity. Increasingly, these forests are being encroached upon by infrastructure development and felled for the purpose of planting cash crops – e.g. the pepper root plant (*Piper methysticum*) known as sakau or saka.[40] State governments and conservation groups in the FSM are working to protect these highly valuable forest lands through means of establishing protected conservation areas and enforcement of watershed forest boundaries (Wortel 2004). In Chuuk, upland forests occur as small, relatively inaccessible stands located on mountain tops and rocky ridges. In Pohnpei, the type occurs throughout the uplands from 1000-2000 feet in elevation. In Kosrae, upland forest covers the steep slopes and some lowlands. The forests of Yap have been greatly modified from their original condition, but remnant examples exist (TNC 2003).

Palm Forests

Palms are a component of forests throughout the FSM, and occur in dense stands on Pohnpei and Chuuk especially in areas where the primary forest has been disturbed. On Chuuk, the common species is the endemic *Clinostigma carolinensis*, while on Pohnpei the endemic *Clinostigma ponapensis* is common and there are two species of *Ptychosperma*: *P. hosinoi* and *P. ledermanniana*; the latter of which is also

[38] Two endemic forest species (*Schefflera kraemeri* and *Semecarpus kraemeri*) are found only in small montane forest remnants on Uinipot Peak on Tol Island in Chuuk. The same forest fragments host a small endemic tree, *Randia carolinensis* (WWF 2009).

[39] Trees in this forest include *Atuna racemosa* Raf. Subsp. *Racemosa*, *Campnosperma brevipetiolata* Volkens, *Clinostigma ponapense* (Becc.) H.E. Moore & Fosberg, *Fagraea berteroana* A. Gray ex Benth. Var. *sair* (Gilg & Benedict) Fosberg, and *Elaeocarpus carolinensis* Koidz (Balick et al. 2009).

[40] Informatioin partly from a three-part series written by O.L. Wortel in 2004, "Can Pohnpei Save the Last of its Native Forests?", discussing the degradation of upland watershed forests for the purpose of planting sakau and other environmental depredations affecting native forest cover, which relied on a host of other reports on the subject, noteably those undertaken by The Nature Conservancy and the Asian Development Bank.

found on Kosrae. Endemic palms, particularly in the mountains of Pohnpei where the palm forests are pure native *Clinostigma* (TNC 2003), attain heights of 25-30 m (80 – 100 ft), and also extend into upland forest with a *Maesa carolinensis* association at the lower altitudes (450 to 600 m). The endemic palm, *Clinostigma ponapensis*, forms the upper layer of the *Maesa carolinensis* association. Palms such as *Ptychosperma hosinoi*, *P. ledermanniana* and *Metroxylon* are also found in the montane forests (WWF 2009) of the islands. Forests of the ivory nut palm, *Metroxylon amicarum* occur in wet locations on Pohnpei, Chuuk, where they are endemic, and can also be found in Kosrae. Ivory nut palm forest is dominated by the ivory nut palm and is commonly located at the edge of wet areas (including rivers and streams) and often forms pure stands (TNC 2003). In recent years, the palm *Heterospathe elata* is spreading in some areas on Yap. Coconut and betel nut are common throughout the FSM, especially about inhabited areas, and a number of other palms have been introduced (Falanruw, 2002). Palm trees are useful culturally and economically, for a multitude of uses[41]. Today, many of the native palm forests are under threat and endangered from clearing for agriculture and commercial cropping[42], as well as infrastructure development (TNC 2003).

Secondary (Agro) Forests

When the vegetation of the FSM was first mapped, a type of forest was found that could not be classified as wild forest because it was mostly made up of food-bearing trees and other useful and ornamental species planted by people around residences, homesteads and villages. The type was labeled as "agroforest" to signify the combination of agriculture and forestry practiced in Micronesia (Falanruw, 2002). Agroforests are immensely important to the cultural diversity of the FSM. A high proportion of the plant species found in secondary forest areas are comprised of trees or other overstory and shrubs which yield food, fruit or other useful products (CCNC, 1997). Although agricultural activites quite often displace native forest cover – particularly under the auspices of an increasingly commercialized and consumptive lifestyle in the FSM – the traditional, conservative form of the agroforest is one of high diversity multi-cropping and integration into the functioning ecologies of the islands. The system is best classified as a "multistory tree garden" because it is not limited to the area immediately around the house compound but extends throughout the landscape (Raynor and Fownes 1991). The system is marked generally by an upper canopy of coconut and breadfruit trees, a midlevel canopy of herbaceous and smaller woody perrenials often used for medicine, along with citrus groves, and a lower canopy of annual or perennial root crops, especially yams, tapioca and taro, with bananas, papaya and other fruit crops in relative abundance (Balick et al. 2009). The type varies throughout Micronesia. In Pohnpei it depicts areas from early to late stages of shifting agriculture, as well as settled

[41] Parts of the *Ptychosperma hosinoi* and *P. ledermanniana* are edible: the heart of palm from this species is edible, and the species seeds profusely (TNC 2003).

[42] Although native palms are resilient under natural disturbance regimes of tree windfall, observations in areas currently being cleared for sakau cultivation suggest that Clinostigma does not re-establish well after large-scale disturbances (TNC 2003).

homesteads. In Chuuk the type consists largely of areas dominated by coconuts and breadfruit on sloping land. In Yap the type represents long established tree garden/taro patch systems involving landscape architecture to manage water flow through the system. While agroforests are most extensive (57%) on the mapped islands of Chuuk, they are most diverse on Yap (Falanruw, 2002). Secondary forests exist in a wide range of systems, from the lowlands where the majority of the FSM population resides, to the slopes, ridges and inland hills and mountains of the high islands (Balick et al. 2009). Hibiscus and bamboo are common secondary vegetation species throughout the FSM as well. In Yap, there is a characteristic set of native species that comes up in disturbed areas and eventually develops into native forest. In many areas of Micronesia however, invasive species interrupt the succession of secondary vegetation to forest. An example of this is the large areas throughout the FSM and especially in Pohnpei that are dominated by *Merremia* vines (Falanruw, 2002), which ultimately dominate and choke out both agroforests and primary forests. As populations grow, and the utilization of the land and soil to extract profit becomes a greater force, the trend will likely be for secondary forests to continue to increase in the FSM, relative to primary forests, despite the continued westernization of the Micronesian diet.

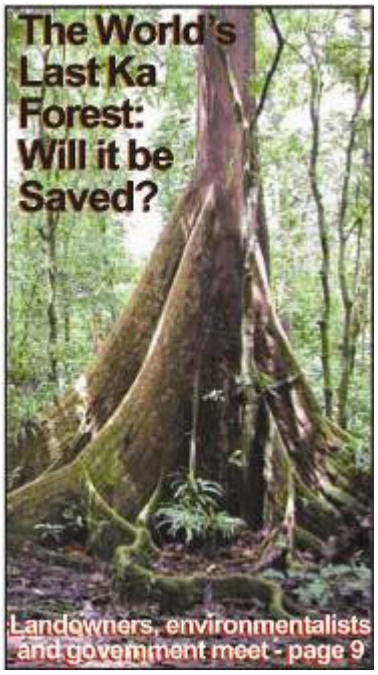
Grasslands and Fern-Sedge Savanna

FSM's forests are associated with several different types of grasslands. These include: the savannas that occur as a distinct community in Pohnpei (Palikir), Chuuk (Fefan), Kosrae (Menke) and Yap (Wa'ab) with the characteristic highly inflammable grass *Imperata cylindrica* and several short stature tree species dotting the grasslands. The type is most limited in Kosrae (TNC 2003). Extensive dry *patanas* that are generally devoid of tree flora (except in the valley bottoms) are found on all the main islands. They are dominated by the grass *Cymbopogon nardus* (*mana*). Wet *pathana* grasslands occur at very high elevations around 2000 m in association with upper montane forests (**Figure 6**), containing the characteristic tussock grass *Chrysopogon zeylanicum* and a scattering of *Rhododendron arboreum zeylanicum* trees. Then there are the *damana* grasslands that occur moreso in Yap, and are believed to have resulted through forest clearing and repeated firing (Falanruw, 2002). This human-induced grassland is relatively extensive in the larger high islands of Yap, Chuuk and Pohnpei States, and is increasing in area due to frequent firing which destroys the forest edge and tree regeneration. Dominant grasses include *Paspalum*, *Dimeria*, *Ischaemum*, and *Dicranopteris* (staghorn ferns) (CCNC, 1997). In Yap however, where the type is more extensive and related to a long history of a monsoon rainfall and drought pattern, there is a set of native savanna species including some endemics (Falanruw, 2002). In Pohnpei, the fern-sedge savanna is an important ecosystem as it is one of the habitats for the endemic Pohnpei short-eared owl, a species which is endangered (IUCN 2008).

FIGURE 7: Pohnpei High Ridge Fern Savanah

1.3.2 Freshwater wetlands

In a report on a visit to Kosrae in 1827, F.H. Kittilitz included a drawing of a tree named "ka" (the Kosraean name for *T. carolinensis*), which he apparently thought was "an especially stately specimen" of *T. catappa* L. (Ritter and Ritter 1982, p. 210-211). *Terminalia carolinensis* was described in 1932, when it was recognized as being very similar to *Terminalia crassiramea* Merr. but distinguishable "by its fewer-nerved leaves which are much more acute at the base and also by its large somewhat compressed fruits" (Kanehira 1932, p. 673). In this century, Senator Noah Idechong of Palau, considered by many to be the father of modern conservation in Micronesia[43], stated, "That is an amazing forest…there is nothing like it in Micronesia. It kind of reminds me of the Redwoods of California, these majestic trees that tower a hundred feet in the air. I don't know what it is, but it is unique," in a description of Yela to the Governor and his Cabinet. "It is something that will require special attention from Kosrae…That is going to be the toughest but also the most important decision that has to be made" (Wortel 2004). The last intact stand of *Terminalia* (*Ka* in Kosrae) in the world exists in Kosrae, one of 13 original freshwater swamps that inhabited the deep valleys and flood plains of the steep rising mountain ranges of Kosrae (Raynor 2000). A proposed road threatens this ecosystem and thus must be considered one of the most highly threatened ecosystems in the Micronesian sub-region. Other threats to the reamaining remnant Ka forests on Kosrae are cultural and economic: master carvers use the trees as the preferred wood for canoes in competitive island races. For the canoe builder, it is also a skill that brings him desperately needed income. The families that own the land where the Yela Ka forest is are working with international NGOs to thwart efforts to build the road through this awesome ecosystem, which is one of the last viable refuges of the threatened Micronesian pigeon (Ewel 2003). Development pressures are huge despite a declining population on the island as it continues forward under U.S.-mandated government downsizing and public sector reforms, traditionally the largest employer on the island. As the local economy flounders, Kosraeans emigrate abroad.



Source: Micronesian Alliance

[43] Largely through his galvanizing efforts to establish the first conservation NGO in Micronesia, the Palau Conservation Society; PCS remains the model for, and helped set off the primary conservation NGOs in the FSM: Conservation Society of Pohnpei (1998), Kosrae Conservation and Safety Organization (2000), Yela Environment Landowners Authority (2005), Chuuk Conservation Society (2006), and others.

Of all of the biomes – inclusive of ecosystems and species – freshwater wetlands are probably the least well-known. In the FSM wetlands currently make up about 15% of the land area of FSM[44], and are both natural and man-made. Among the natural occurring wetlands, or riparian zones, are riparian forests, rivers and streams (including waterfalls with deep pools), riverine floodplains, freshwater springs and pools, and freshwater marshes. The most important of these are the FSM's network of major rivers and subsidiary streams that commence in the watersheds of the high islands and radiate through the rural villages and population centers, into the mangrove channels and marshes, across the valleys and lowland plains and finally into the sea by way of the estuaries and reef passes. The total collective length and area that these systems cover is, again, not well known, and further study and GIS mapping is needed in order to fully understand and protect this highly valuable resource. FSM's freshwater availability is considerably influenced by the country's generally wet climate, and its location in respect of the equator. Located in the humid equatorial region on the southern edge of the typhoon belt, the islands at the eastern end of the Caroline chain are wet year-round, with precipitation becoming more seasonal toward the west. Rainfall in Pohnpei averages more than 4,500 mm annually, while parts of Kosrae, 550 km to the southeast, receive more than 6,400 mm per year (WWF 2009). Pohnpei and Kosrae are the two highest points for thousands of kilometers (TNC 2003). Consequently, all major rivers originate in the watersheds of these high islands. Pohnpei has at least 40 major rivers (PVB 2009) and Kosrae at least 15 (KSL 2004). The Yap main islands, within the Tropical Dry Forest Ecoregion of the FSM, have annual rainfall ranging from 2,250 to 3,400 mm. Rainfall is seasonal, with a distinct dry season lasting from January through March (WWF 2009). The islands get frequent heavy rains from May through November, which largely helps the one man-made lake in the FSM to maintain a supply of freshwater to the 12,000+ residents on Yap proper (Wa'ab) year-round. Information on rivers and streams for Yap and the lagoon islands in Chuuk is currently quite limited and further assessments are required.

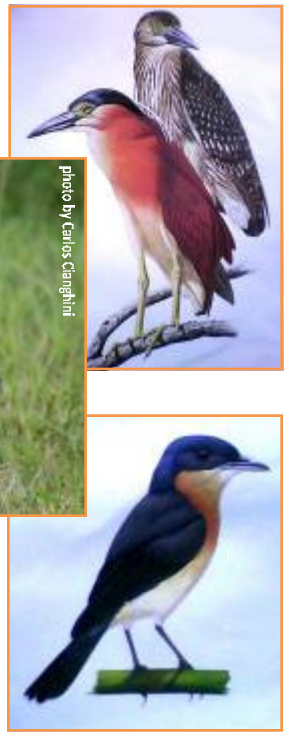
The river and stream basins vary in size, and most rivers have some freshwater marshes and swamps associated with them. Some rivers also show extreme seasonal fluctuation of flow: many have a propensity for flash flooding after large rain storms in the high interior, while others may even nearly dry up given any prolonged lack of precipitation on the islands. Most major rivers in FSM also have complex profiles, and are steep in their upper reaches before flattening out in their middle and lower reaches[45]. Nonetheless the geography and ecology of the major river systems of the FSM are varied and fascinating as ecosystems; some of the main rivers on the soutwest portion and coast of Kosrae in particular, one of the very few roadless areas left on any of the larger high islands of the Pacific, are extreme marvels of purity and tropical island diversity (Wortel 2005).

[44] Actual specific data is not readily available and this figure thus represents the author's estimation based upon the research of various studies, assessments and documents discussing freshwater systems. As such, this is a limited assertion.

[45] Even so, waterfalls are a consistent riparian feature on the high island landscape and many exist on the very lower reaches of the watershed, near coastal and mangrove wetland ecosystems.

There are a number of invertebrates in the freshwater systems, including snails and freshwater prawns. Both are important to the river ecologies as cleaners and scavengers, respectively. Among the vertebrates in the aquatic systems are several species of freshwater fishes indigenous to FSM[46] (COM-FSM 2007, TNC 2003), as well as fresh water eels. They are generally riverine or marsh dwelling and their main habitats are in riparian zone streams. Wetlands also contain some reptiles, both introduced species, including one species of crocodile which has turned up in Yap in the past (Falanruw 2002), and a large monitor lizard, originally introduced by the Japanese during their period of occupation in the islands. Inland water bodies and wetlands also provide habitats for a multitude of water birds. Within the wetlands of the FSM, one will find most of the species of birds that exist, particularly the Pacific Reef heron, Chuuk flycatcher, Nightingale reed warbler, the Micronesian kingfisher, Yellow bittern, Rufous night heron and the White-browed rail, all of which transit between the coastal marshes and the freshwater wetlands quite easily. Floodplains associated with freshwater aquatic systems are also among FSM's most valuable habitats. These systems provide water for the larger mammals of deer and boar. Wetlands are also home to several species of freshwater algae, diatoms and other phytoplankton; floating plants; rooted aquatics; grasses, sedges, reed bamboo and ferns. Many of the wetland sites in FSM are now recognized as important, both regionally and globally; a vast system of coastal freshwater marsh, swamp forest, mangrove, estuaries, lagoon and bay in Kosrae – the Utwe-Walung Area of Biodiversity Significance (TNC 2003) – was designated as a Biosphere Reserve, the first such designation in the Pacific at that time[47]. Most of the freshwater systems are facing threats from agricultural development, nutrient runoff from small farms, pollution from piggeries and solid waste, and degradation from insfrastructure development and landfilling (EPA 2008, TNC 2003).

FIGURE 8: Freshwater wetland birds



Source: US Fis & Wildlife Service

[46] Includes two species of Pohnpei river goby, which is undescribed and quite rare, but found on the major rivers of Pohnpei (Nanpil-Kiepw, Senipehn, Nanpil and Lehn Mesi) and Kosrae (Menke).

[47] The United Nations (UNESCO) Man and Biosphere (MAB) programme designated this site of high biological significance as a Biosphere Reserve in 2005, along with another designation in Palau shortly thereafter, the first and second such reserves in the Pacific. This effort will be further detailed in Chapter 2.on the discussion of status and implementation of the NBSAP.

Freshwater Marshes

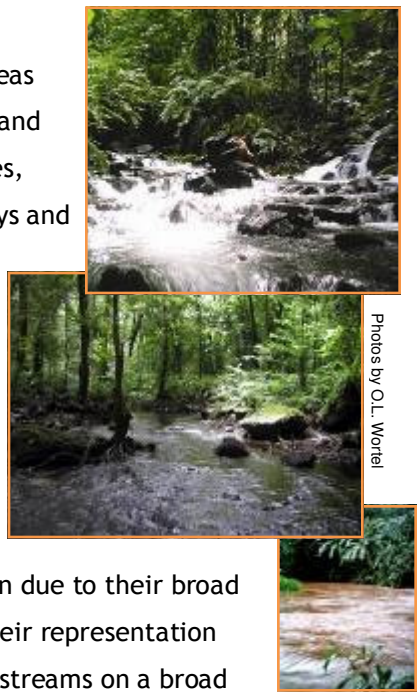
Marshes are filled with grasses, sedges and herbs growing in standing water most of the year. Some marshes are located at higher elevations where water collects and drainage is impeded. Most marshes in the FSM are dominated by tall *Phragmites karka* grass. Other important plants are associated with marshes however such as the endemic *Metroxolon amicarum* ivory nut palm of Kosrae, Pohnpei and Chuuk, and native sedges and unusual marsh vegetation such as the *Hanguana malayana* of Yap. Many marshes are used for taro cultivation, or were so used in the past (Falanruw 2002), including in all the inhabited islands of Yap and Chuuk States as well as in all the outer islands of Pohnpei State (CCNC 1997). In the FSM, there are several types of freshwater marsh ecosystems. The most common is the coastal freshwater marsh, a community that is found in all 4 states. These marshes are generally located slightly above sea level, often landward of mangroves. Most are vegetated with extensive patches of *Phragmites karka* however others include patches of sedges, and in Yap, *Hanguana malayana* and *Eriocaulon sexulare var. micronesicum*. In Pohnpei and Chuuk the ivory nut palm commonly grows at the edge of marshes with species of sedges and other herbaceous growth (TNC 2003). The other primary system found in the FSM is the montane perched freshwater marsh: a highly unique ecosystem found only in Pohnpei at high elevations. The typical swamp vegetation is dominated by sedges (*Thoracostachyum pandanophyllum* and others), grading into swamp forest of *Metroxylon amicarum* and Hibiscus, with drier areas dominated by *Cyathea nigricans* and *Clinostigma ponapensis*. At Nanalaut, the highest point in the Caroline archipelago (elevation 750m), *Clinostigma* is an emergent species to 30 feet high; main canopy to 10 feet high. In terms of flora, an endemic Pandanus species is found in this marsh area (TNC 2003).

Riparian forests

Riparian forests are a broadleaf evergreen forest on moist soil, adjacent to streams, often richer in species than forests on drier upper slopes. In the FSM, many species within this forest type are endemic. The trees within this zone also provide food for the key avian and mamilian species, particularly the fruit bats, which like to feed on the nuts of these trees. This ecosystem often merges with upland broadleaf forest above, and swamp forest and mangrove on lower coastal bottomlands. The species composition varies between high islands. Trees are often larger than surrounding forest and ferns and epiphytes are common. The riverine species *Samadera indica*, previously known only from Palau in Micronesia has recently been found in Yap (TNC 2003). These are a highly threatened type and extensive assessments on their scope and continued viability needs to be undertaken[48].

[48] The US Forest Service has been involved with studies in Kosrae and throughout FSM wetlands for a number of years and is currently in the process of assisting the FSM for comprehensive assessment and strategy document for the Federation's forest ecosystems. It is expected that this paper will be presented to the US federal government in mid-2010.

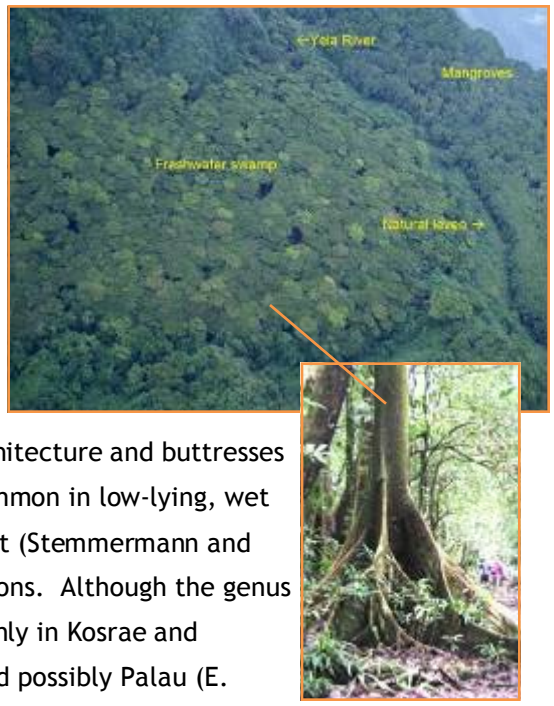
Rivers and streams



Riverine systems in the FSM are generally isolated areas within islands and areas where unique species are found. They are also very important in freshwater and nutrient regimes (Falanruw, 2002) throughout the various natural communities, from the cloud forests to the reefs, transferring upland nutrients to the valleys and to the brackish swamps where fish and other marine life depend on them. They also are key elements in the transpersal of the seeds of the native fauna of the high islands. Perennial stream and river communities occur mainly in the Eastern Caroline Islands of Pohnpei and Kosrae. In Yap streamflow may become intermittend during years with more severe drought. The type blends into upland forest above and into swamp forest, estuary and mangroves at lower elevations (TNC 2003). Freshwater streams and rivers in particular are singular primary conservation targets by the nation due to their broad environmental communal, traditional and socio-economic importance, and their representation within almost all freshwater systems (TNC 2003). Existing data on rivers and streams on a broad scale, as well as classification into narrower freshwater system categories remains a much needed priority, as major data gaps exist and need to be addressed in upcoming assessments (TNC 2003).

Swamp Forests

FIGURE 9: FSM's last intact freshwater swamp



Freshwater forested wetlands are found on many of the high islands of Micronesia. The less disturbed wetlands are characterized by closed canopies of large trees in genera such as *Campnosperma*, *Calophyllum*, *Metroxylon*, and *Terminalia*. Heights that often exceed 35 m, large buttresses, pneumatophores, and extensive epiphyte communities (Hosokawa 1952, 1954; Maxwell 1982) make these wetlands some of the most impressive and distinctive forests in the region. The most magnificent swamp forests in the FSM are the tall *Terminalia* forests of Kosrae (Falanruw, 2002). *Terminalia carolinensis* is a large tree (up to 35 m tall) with distinctive pagoda-like crown architecture and buttresses that can rise several meters above the ground. Although most common in low-lying, wet sites, the species, which is classified as a facultative wetland plant (Stemmermann and Proby 1978a), can also be found in riparian areas at higher elevations. Although the genus *Terminalia* has a pantropical distribution, *T. carolinensis* occurs only in Kosrae and Pohnpei (Stemmermann and Proby 1978a; Fosberg et al. 1979), and possibly Palau (E.

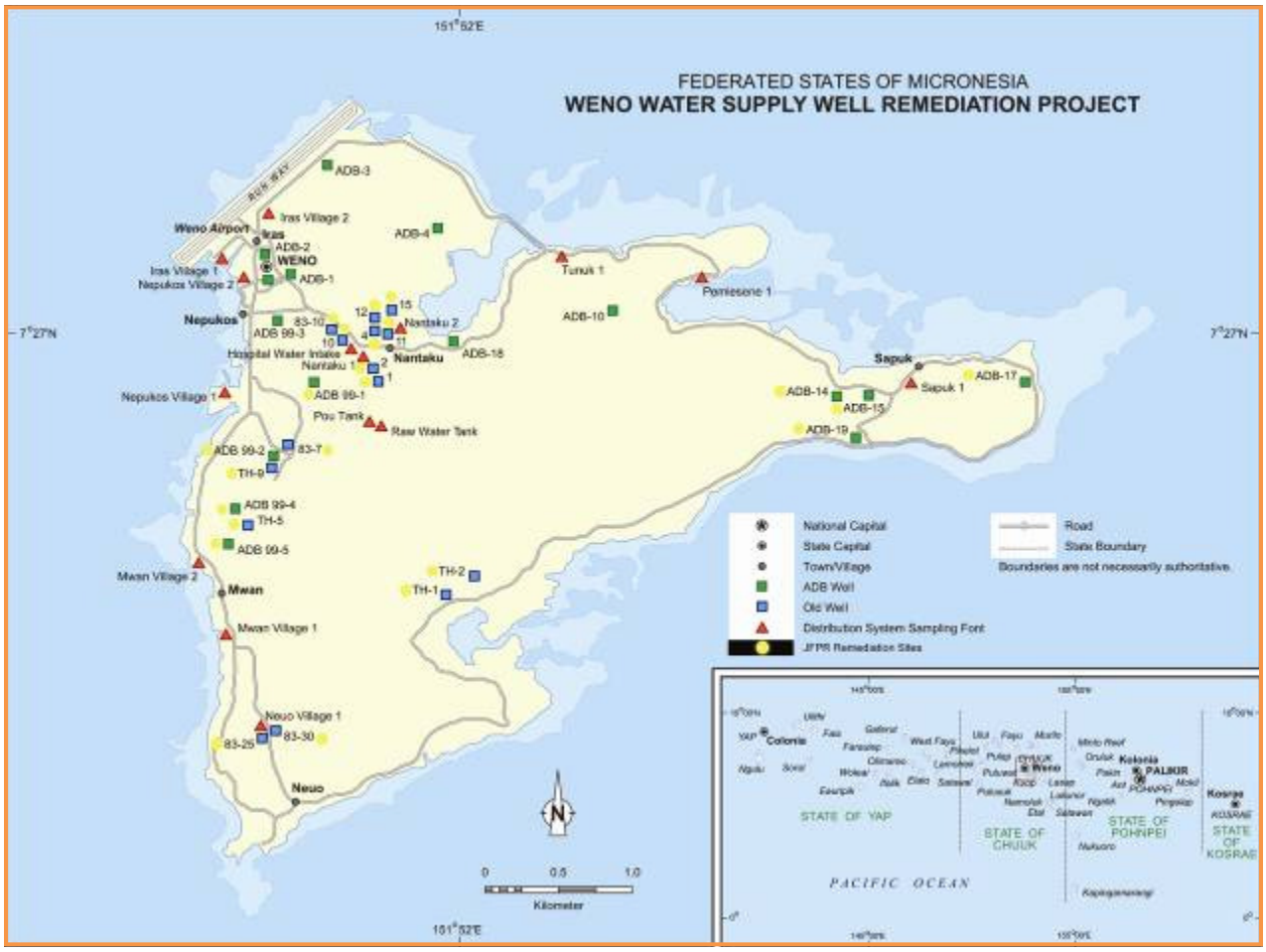
Waguk and K. Rengulbai, personal communication). *Terminalia* forests are likely to have been common once on Pohnpei, but they are now common only in one remote watershed. Freshwater swamps dominated by other species are still found in Pohnpei, but many of these wetlands have been converted to open taro patches of *Cyrtosperma chamissonis, Alocasia macrorrhiza, or Colocasia esculenta*. *Terminalia* forests have been used for agroforestry by Kosraeans for nearly 2000 years (Athens et al. 1996); their endurance as both wetlands (with apparently unaltered hydrology) and agroforests is probably unique among the wetlands of the world (Chimner and Ewel 2004). Nevertheless, remarkably little is known about them. Freshwater forested wetlands usually cover no more than 3-6% of the total land area of a Micronesian island (e.g., Whitesell et al. 1986; MacLean et al. 1988), but their ecological and socio-economic importance is likely to be much greater than their areal extent would suggest (Drew et al. unpubl. ms.). In the FSM, freshwater swamp forests account for nearly 8% of all wetlands (Paul, Edward 2005), most found in Kosrae (345 ha), Pohnpei (214 ha) and Yap (155 ha). Because these wetlands are generally located in the lower reaches of streams and rivers between uplands and mangrove forests, they play important roles in trapping sediments and protecting sensitive seagrass beds and coral reefs. Other functions include floodwater retention, improvement of water quality, provision of habitat for fish and wildlife, carbon sequestration (Chimner and Ewel, unpubl. ms.), and production of wood, thatching material, food, and medicines. Despite their importance, these exceedingly rare wetlands are most seriously threatened forest type in Micronesia (Allen et al.), as development pressures bring opportunities for conversion to agriculture and other types of land uses (Drew et al. unpubl. ms.)

> Peatlands are the most widespread and numerous of all wetland types in the FSM and can form under almost any climate regime if supplied with the proper hydrologic conditions. Tropical peatlands represent as much as 10% of the total carbon stored in peatlands, which cover roughly 4 million km2 or 3% of the Earth's land surface. Peatlands accumulate carbon because plant production is faster than decomposition, allowing the build up of peat, which is partially decomposed plant material. Micronesian peatlands accumulate peat because of slow decomposition of roots and wood under anaerobic conditions that result from constant high water levels (Chimner and Ewel, 2004).

Aquifers and springs

Aquifers and underground spring waters are a continous feature of the Micronesian landscape, and certainly one of the most valuable resources. These freshwater systems deep under ground dot the basalt landscape on the high islands and are a major factor in keeping the rivers cool and flowing year-round. On the atoll islands, these underwater freshwater lenses also exist and provide a primary source of drinking water for the people that inhabit them (CCNC 1997). In fact, the small islands for each state are fully dependable on rain water and shallow wells that reach the freshwater lens due to the low elevation of the islands (SOPAC 2009). Climate change however threatens much of the freshwater resource on atoll islands, both the underground drinking water, as well as the standing marshes and wetlands that are used to support the extensive taro patches on the inhabited atolls of the FSM. The high islands also utilize these aquifers for numerous wells, particularly in the Chuuk lagoon islands (**Figure 10**).

FIGURE 10: Aquifer use as a water resource on high islands (Weno, Chuuk) in the FSM



Source: JFPR-ADB Weno Water Supply Well Remediation Project Inception Report, 2009.

1.3.3 Coastal and marine ecosystems

FSM has a vast system of coastal habitats that include estuaries and lagoons, mangroves, sea grass beds, salt marshes, reefs and large extents of beaches, including barrier beaches and spits. Its coral lagoons are estimated at an area totalling 7,190 km2 (CCNC 1997), harboring some of the most immense near shore marine life and resources that the world has remaining. Its coral reefs, estimated at 14,517 km2 (Birkeland, Edward et al.), contain more than 1,100 species of fish, 350 species of coral, and thousands of species of sponges and other creatures that inhabit the waters of the FSM (CSP, NOAA, 2008). In the FSM there are two distinct marine systems identified as high-island near shore marine and atoll nearshore marine ecosystems. High island nearshore marine is characterized by an extensive and diverse marine system made up of a number of integrated communities including coastal marine depressions, bays, seagrass meadows, lagoonal holes and channels, coral beds and thickets, sand flats, reef flat and crest and outer reef slope (TNC 2003). Atoll nearshore marine is a thriving and abundant marine system composed of a number of integrated communities including intertidal areas, sandy and

coralline lagoons, channels and reefs in association with atolls (TNC 2003). The majority of people living on these small islands depend heavily on the natural resources from the near shore marine ecosystems in particular for their food, livelihoods, and traditional cultures. Chuuk Lagoon alone is one of the deepest and largest enclosed lagoons (atoll) in the world, with huge reef passes through the western barrier reef[49] that are major spawning and aggregation sites for such globally threatened species as grouper, trevally, sharks and turtles. For Chuuk indeed, the marine environment is considered the basis for Chuukese culture, being the principle source of subsistence, recreation and commerce (CCNC 1997). 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). 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). Kosrae's reefs in fact contain some of oldest and healthiest corals in the world today (KVR 2007)[50]. 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. More than 200 species of coral (Donaldson et al., 2007) and a total of 38 species of algae have been documented in Kosrae (USACOE, 1989a). However, recent coastal development, land use patterns and encroaching sea levels have resulted in considerable coastal erosion and degradation of the coastal mangrove ecosystem, placing the health of Kosrae's reefs at greater risk (Maragos, 1993).

Near-shore marine fisheries in the FSM

Most of the marine fish species recorded for the FSM are reef-associated (873 of 1,125). And while ecosystem and species diversity is quite high and in relatively healthy condition, there are signs that over harvest is taking a toll. There are few catch and export data, but some market information suggests that the fisheries in FSM's reefs are substantial. The gross value output of FSM fisheries was estimated at US$86.4 million in 1998, and while commercial export has the greatest impact on FSM fisheries, over-fishing by foreign vessels has also been documented. Better assessments and tighter regulations of fisheries resources within the FSM are needed. In Pohnpei for example, a market-based analysis conducted in 2006 stated that the near-shore fishery resources are likely to continue todecline dramatically. A market-based analysis indicated that at a minimum, 2,500lbs 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). The numbers reflect similar trends in the other FSM states as well and are clearly not sustainable.

Source: CSP, 2006

[49] Fanufan Reef and Pinanu Pass (Wortel 2004).

[50] Sitting outside of the typhoon zone, Kosrae's southern tip, with a close fringing reef, has hard corals at depths of 3-5 m that are hundreds of years old: old-growth coral.

Yap has the greatest diversity in the FSM, particulary in terms of its coastal and marine biodiversity (Falanruw 2002, Allen 2007). It has 14 primary mangrove species and its coral reefs – despite a massive super typhoon that pounded the island in 2004 – are in very good condition with 787 species of fish identified in 275 genera and 76 families (NOAA 2008)[51]. As spectacular as these environments are, however, there are mounting pressures from population growth, overharvest, habitat destruction, changing cultural practices, invasive species and climate change (FSM PAN, 2008). Over the last two decades, the FSM has experienced at least two highly destructive typhoons - 1990 in Pohnpei and 2004 in Chuuk and Yap - as well as some bleaching, with limited mortality: in 1998 20% bleaching of corals occurred in Yap with as a result of the severe El Nino weather pattern that year, and in 2004 minor bleaching occurred in Kosrae and Pohnpei (NOAA 2006). All marine and coastal biodiversity are further threatened by contamination of these waters with oil and tar released from grounded boats and sunken ships on the reefs, as was seen in 2002 with the M/V Kyowa Violet (Cargo) grounding in Yap and the continuing seepage of the Japan 4th Imperial Fleet sunk in Chuuk Lagoon (FSMGOV, 2002), as well as ballast water from the increasing container and fishing vessels that harbor alien invasive species.

New and rare marine species in FSM

Rapid Ecological Assessments (REAs) were conducted in coordination with conservation NGOs in the FSM between 2005 and 2007 and revealed an even greater diversity in the reefs and near shore marine areas than previously known. A host of new species of hard and soft corals, vertabrates and invertebrates were discovered, including 59 new records of fish species in Kosrae, 349 new fish range records, as well as 91 new records of fish in Yap, and with 161 new distribution records and one new species of fish in Pohnpei, along with 42 species of corals not previously known to occur[52] (NOAA 2008, CSP 2006), One of the more notable discoveries in the Pohnpei REA is the attractive banded pipefish, *Dunckerocampus naia*. The species was previously known from less than 10 specimens collected or observed at southern Japan, Guam, Solomon Islands, Fiji, Kalimantan, and the Raja Ampat Islands of Indonesia. A pair was observed in 20 m depth in a deep crevice. Further, although Pohnpei endemics are scarce, during the course of the REA several species that are entirely or mainly restricted to central Pacific waters were found to be relatively common around the island and offshore atolls. These include the damselfishes *Chrysiptera traceyi* and *Pomacentrus bipunctatus*, and the wrasse *Cirrhilabrus luteovittatus*. Other restricted range species include the central Pacific moray eel *Gymnothorax marshallensis* and the wrasse *Cirrhilabrus katherinae*, which was previously known only from Japan and the Mariana Islands.

Source: CSP, 2006

[51] 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.

[52] Chuuk (Chuuk Conservation Society) is 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 (NOAA 2008).

Reefs

Extreme Biodiversity

About 350 hard coral species occur in the FSM's coral reefs, and a large range of species of spiny lobsters and many other invertebrates, sea turtles and sevreal species of dolphins (Falanruw, 2002). The shallow reefs of FSM are a prolific mix of diversity, encompassing an estimated 14,517 km2 of coral (Rohmann et al., 2005). The FSM has identified 22 priority marine conservation sites in these reefs for protection due to their high biodiversity profiles, value to the local economies of communities and threats to their continued climax functions. Together, these sites encompass a total area of nearly 83,000 hectares. It is not uncommon to see living cover of reef-building corals in these internationally recognized biomes of up to 75% (Turak and DeVantier 2007), with exceptionally high visibility year-round. To date, most of the FSM's reefs have escaped serious degradation due to bleaching.

Source: (TNC 2003, NOAA 2008)

Photos by Katrina Adams, Kosrae Village Resort

Famed for their spectacular beauty, coral reefs are among FSM's most valuable shallow water marine ecosystems. The condition of FSM coral reef ecosystems is generally good to excellent. Most of the reefs in the islands are in excellent condition (Birkeland, Edward et al.), with very high water clarity and prolific coral growth (FAO 2005). Each state supports population centers on high volcanic islands surrounded by barrier reefs (Pohnpei, Chuuk) or very broad fringing reefs that are nearly barrier reefs (Kosrae, Yap), and all are invaluable to the continued realization for many in a subsistence lifestyle. All states except Kosrae also include remote clusters of atolls and low coral islands (Maragos and Holthus 1999) that support and attract a broad array of sea life. Spalding *et al.* (2001) estimated total shallow water coral reef area off the FSM to be 5,440 km^2. Crustose coralline algae are abundant on the reefs (Birkeland, Edward et al.). 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. Recent surveys conducted at selected sites indicated a predominance of healthy corals with 40% to 60% live hard coral cover overall around the island. The status of coral reefs are in good condition, with percent cover of hard corals ranging from 64% at Inpeah, Molsron Malem; 60% at Inpucspucsah Utwe; 47% at Tukunsru Walung; 63% at Insrac Meloh Tafunsak; and 48% at Saclem Tafunsak or the Trochus Sanctuary.

Pohnpei Island has a well-developed barrier reef and associated lagoon that has outstanding biological significance (NBSAP 2002. TNC 2003)[53] (**Table 5**). 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). The people of Pohnpei, like those in many developing Pacific nations, depend on this diversity for subsistence and, increasingly, for cash income (Birkeland, Edward et al., 2005). As a result, pressure on reefs and fisheries is currently growing and unsustainable (CSP, 2006).

TABLE 5: Number and size of Areas of Biodiversity Significance by type in FSM

ABS Site Type	Number of ABS sites	Area (Hectares)
Terrestrial Sites		
Yap	3	651.94
Chuuk	9	4,328.06
Pohnpei	9	12,833.28
Kosrae	2	4,835.04
Total	**23**	**22,648.32**
Marine Only Sites		
Yap	6	9,471.10
Chuuk	10	20,683.29
Pohnpei	5	12,480.50
Kosrae	1	54.52
Total	**22**	**82,689.39**
Coastal Marine Sites		
Yap	21	24,007.43
Chuuk	20	77,089.91
Pohnpei	18	75,695.26
Kosrae	5	1,466.07
Total	**64**	**178,258.67**
Coastal Freshwater Sites		
Yap	2	31.76
Chuuk	11	936.66
Pohnpei	3	5,283.09
Kosrae	4	1,904.89
Total	**20**	**8,156.39**
OVERALL TOTAL	**130**	**291,752.77**

Source: A Blueprint for Conserving the Federated States of Micronesia, 2002

[53] In the 2002-2003 assessment on Area of Biodiveristy Significance, Pohnpei was identified with 88,176 hectares of biologically important marine and coastal ecosystems (TNC 2003).

Seagrass beds

FSM's coastal waters have extensive sea grass beds that often occur in association with coral reef ecosystems or within estuaries and lagoons (CCNC 2006). FSM's seagrass habitats can be generally categorised into six habitats: estuaries, sheltered fringing reef, exposed fringing reef, patch reef, barrier reef and atoll. Seagrass meadows in the region as a whole are in relatively healthy condition compared to many other regions globally CSP 2006). Sea grass meadows are of extremely high value to the FSM in terms of the ecological services they provide: provision of habitat, feeding grounds and protection for juvenile species of reef, mangrove and paleagic fish, trapping of silt and cleaning of reef areas, and perhaps equally important on a global scale, the vast seagrass beds in the FSM sequester – along with its forests and reefs - huge amounts of carbon[54]. It is hard to determine exactly how many species of seagrasses have been recorded in FSM waters due to the sporadic and dispersed data available[55]; however, the information on record indicates species diversity decreases from east to west, from Kosrae to Yap. Indeed, the high island of Kosrae with a fringing reef appears to be an extraordinary anomoly[56] in terms of the species diversity of its extensive seagrass beds: on the reef flats, in a total sample area of 2,982 m^2, 9,383 holothuroids[57], comprising 13 species, were recorded. An additional 13 species were recorded off the transects between depths of 0 and 30 m, and an additional two new species discovered, bringing the toal for Kosrae to 28 species (Kerr 1994). Prolific in the estuaries, lagoons and reef flats around both the high islands and the many atolls, including on the south coast of Kosrae in the Okat-Walung coridoor, at Ahnd Atoll outside of Pohnpei, around the western coast of Fefan Island in Chuuk Lagoon and around the islands of Ulithi in Yap, these ecosystems are of particular interest as they are believed to be the main habitat of the critically endangered dugong (*Dugong dugong*) (Falanruw 2002) in Yap, and provide valuable habitats for the reptiles, rays, sharks, crustaceans (crabs), gastropods and most, if not all of the reef fish present in FSM. Further study and moreover, protection, is certainly required for this extremely fragile ecosystem throughout the federation, as they exist in complex interactions with mangrove communities, salt marshes and coral

[54] Seagrass meadows account for 15% of the ocean's total carbon storage (Wikipedia 2009). By ensuring biodiversity health of their primary ecosystems, Micronesians provide a service not only to themselves, but also to the world.

[55] As in FSM, there is a lack of information on the status and health of seagrasses worldwide (Short, Mckenzie et al. 2004).

[56] There are 60 described species of seagrasses worldwide; tropical seagrasses occupy a variety of coastal habitats and typically occur in mostly shallow, sheltered soft-bottomed marine coastlines and estuaries. These meadows may be monospecific or may consist of multispecies communities, *sometimes with up to 12 species present within one location.*

[57] The scientific name for seagrasses, which are angiosperms (flowering plants) more closely related to terrestrial lilies and gingers than to true grasses. They grow in sediment with erect, elongate leaves and a buried root-like structure (rhizomes).

reef systems and exert a stablizing effect on the overall environment (Allen 1994). In FSM the preeminent threats are from the propellors on skiffs that zip over the meadows, tearing patches in the fabric of the system and often maiming or killing larger sea life, such as rays, and from road construction along the coastal zone and coral dredging and sand mining.

Estuaries and lagoons

The inshore waters –particularly the bays, lagoons and estuaries - around the high islands of Pohnpei and Kosrae have the highest potential phytoplankton biomass yields in Micronesia (Cowan and Clayshulte, 1980). This results from the very heavy rainfall carrying nutrients from the land into the near-shore waters (FAO 2006). The FSM also has awesome outer island lagoons encircled by its many atoll island groups spread across the north Pacific region. As such, aquaculture activity in Micronesia has included the construction of ponds and facilities for mullet, milkfish, rabbitfish and *Macrobrachium*, farming of seaweed, sponge, and pearl oysters, and hatchery rearing of giant clams. Such activities have the dual benefit of providing financial opportunity to developing economies *and* enhancing biodiversity and ecosystem function in the coastal and marine environments. A good example is the former National Aquaculture Center in Kosrae, which is transitioning toward a fully privatized and operational business through export of giant clams and corals that are cultured at the center and in grow-out sites in selected lagoonal and bay locations with local farmers around the island. Kosrae, like much of the FSM once had many species of giant clam, but now there are few left in the wild - other areas, like Ahnd Atoll and Parem Island in Pohnpei, Fainaw, Eiel and Fananu islands in Chuuk and Elato and Feshaiulap Atolls in Yap still have meaningful native species in situ – so the current aquaculture operation in Kosrae[58] also has the potential for population enhancement of native species in former ecosystems where they were traditionally inhabited. Exporting clams and corals and reseeding ecosystems with key marine species has multiple benefits. Corals grown in tanks and cages on reef flats can be continuously fragmented and used to transplant damaged reefs (BBC 2009).

Photos by Martin Saich

Sources: FAO 2000; TNC 2003; FSM 2009.

With all of the rivers and many atolls that exist, FSM's aggregated coastline has many picturesque and economically important estuaries[59] and lagoons. These complex systems contain a diversity of species and a variety of interconnected coastal habitats that include mangroves, salt marshes and seagrass beds. These systems provide for a wide range of habitats and associated flora and fauna, with a charactieristic high productivity for species. Information on the total number throughout the federation is scattered, but there are likely more than 15 major bays and estuaries of the riverine type that discharge directly to the sea. On lagoons, as has been discussed previously, Chuuk Lagoon is one of the deepest and largest such body in the world and its corresponding diversity of life is immense (CCNC

[58] It is currently run as Micronesia Management & Marketing Enterprises and is working with the FSM national government on a 3-5 year privatization plan as one of the key aims for such public ventures under Compact II with the US government.

[59] Estuary: the lower part of a river where the freshwater and marine environments interchange.

1997). Lagoons encompass nearly 7,000 km2 throughout the nation (**Table 6**). Together, estuaries and lagoons represent some of the premiere priority Areas of Biodiveristy Significance: the Dausokele Estuary and Dau Mwoakote Estuary in Pohnpei, Ngolog Bay in Yap, Yela-Okat Marine area and Utwe-Walung Marine Park in Kosrae and Pou Bay, North Wao, North Fefan and Faichuuk Marine areas in Chuuk, to name a few. These extremely productive ecosystems contain hundreds of edible species of fish and economically important invertebrates including annelids, edible molluscs, shrimps, and mangrove and swimming crabs, all so hugely important to the subsistence lifestyle of these islands. Extensive areas are utilized by many species for reproduction and nursery sites for juveniles. As higly productive and essential as these systems are, they are particularly susceptible to damage, especially terrestrial run-off. Efluent from agriculture and livestock have immediate and direct impacts upon lagoon and estuary systems. In the FSM this is particularly so, as natural communities are condensed into small areas of landscape (Falanruw 2002). Often in the FSM, particularly in cases where urbanization is more rampant and population pressures are evident, government sewage facilities are simply in disrepair and raw, untreated excrement is dumped directly into the estuaries very near where much of the major human development occurs throughout FSM (ADB 2007). This is a continuing problem that severely affects the functioning ecologies of estuaries and lagoons in the FSM, and the species that depend upon those ecologies. Ultimately, it has an effect not only on human health as well, but also on the broader socio-economic fabric of communities in the FSM.

TABLE 6: Total Lagoon Area in FSM, by State

Type	Chuuk	Kosrae	Pohnpei	Yap	Total
	Area in square kilometers				
High Islands	2,129	0	178	26	2,333
Outer Islands	3,013	0	591	1,023	4,627
Total Lagoon Area	5,269	0	770	1,049	6,961

Source: OPS Information Handbook, 1992

Mangroves

Photos by O.L. Wortel

The most distinctive forest type in the FSM is mangrove. These forests have specialized roots inundated at least periodically by seawater and they come in an abundant variety throughout the nation. Mangroves are found along the costs of most of the FSM and are best developed at the mouths of drainage systems. They serve as a natural filtering and buffering system between land and sea. The most extensive areas of mangroves are found in Pohnpei and Kosrae while the mangroves of Yap contain the most species of mangrove trees (**Table 7**) (Falanruw, 2002). They are found occurring throughout the federation on all the main islands and to a limited extent on atolls in the form of narrow fringes along many coasts and in bays and filled lagoons, as in Kosrae[60] (TNC 2003). Diversity of mangrove species ranges from 15 species in Yap to 10 in Chuuk, Pohnpei and Kosrae. The principle tree species include *Rhizophora mucronata*, *R. stylosa*, *R. apiculata*, *Bruguiera gymnorhiza*, *Sonneratia alba*, *Xylocarpus granatum*, *Lumnitzera littorea*, and *Heritiera littoralis*. At the mouths of some rivers and for a short distance upstream, are found pure stands of Nypa fruticans. Subtypes include mangrove depressions (in atolls of the Carolines), Nypa swamps, and Acrostichum swamps. On Alei Islet (Puluwat Atoll) in Chuuk, saltwater depression swamps dominated by *Bruguiera gymnorhiza* trees occur in the interior of the islet (TNC 2003). FSM's mangrove areas amounted to 86 km^2 as determined in a 1987 forestry survey in 1987 (Falanruw). In total, the mangal vegetation in FSM comprises around 25 different species of trees, bushes, herbs and vines, of which about 15 are true mangroves. Occurring within the mangrove habitats are also many species of fish, birds, crabs and reptiles. Mangroves in the FSM are still relatively healthy accross their range and natural zones, but as small a total area that they are, they continue to be used extensively for firewood and as posts and lumber for construction (KIRMA 2007), for trapping of mangrove crabs and fish, as runoff for piggeries, and as "unusable" land they are filled in for construction of homes and other human development, often with solid waste and human refuse (EPA 2008). Similarly, the FSM national government has stated that, "overharvesting is occurring…and there has been extensive use of mangrove wood for woodcarvings and other purposes resulting in over-exploitation occurring in some localities on Kosrae, Pohnpei and Yap (CCNC 1997). Leading local scientists have also urged caution, stating that "throughout the FSM, mangrove forests are

[60] The high rainfall and flat topography of Kosrae's coastal plain allow for the development of extensive mangrove forests, which cover approximately 14% of the land area and twothirds of the coastline (Whitesell et al. 1986). Ten mangrove tree species, including one hybrid, are present on the island (Duke 1999), of which *Sonneratia alba* J. Smith, *Bruguiera gymnorrhiza* (L.) Lamk, and *Rhizophora apiculata* BL are the most common (MacLean et al. 1988; Ewel et al. 1998a).

under threat from roads altering the flow of freshwater, dredging operations, oil spills…it is important to develop mangrove management programs and to protect adequate areas of mangroves in order to maintain their ecosystem services, which far outweigh their value as timber" (Falanruw 2002). Many of the most endangered and pristine sites have been identified by the FSM as priority areas for conservation (TNC 2003).

TABLE 7: Species of Primary Mangrove Trees in the FSM

Mangrove Species	Kosrae	Pohnpei	Chuuk	Yap
Avicennia alba	X			X
Bruguiera gymnorrhiza	X	X	X	X
Ceriops tagal				X
Dolichandrone spathacea				X
Excoecaria agallocha			X	X
Heritiera littoralis	X	X	X	X
Lumnitzera littorea	X	X	X	X
Nypa fruticans	X	X	X	X
Rhizophora apiculata	X	X	X	X
Rhizophora X lamarkii (hybrid)	X	X	X	X
Rhizophora mucronata	X	X		X
Rhizophora stylosa	X	X	X	X
Scyphiphora hydrophyllacea				X
Sonneratia alba	X	X	X	X
Xylocarpus granatum	X	X	X	X
Total number of species	11	10	10	15

Source: Falanruw, 2002

Atoll and limestone forests and littoral beach strands

The glimmering and pristine beaches and atolls of the FSM are some of the most beautiful ecosystems on earth. Combined with the bountiful and multi-colored reefs and the crystal blue waters of the lagoons and ocean that surround them, they are nearly too much to behold all at once. Perhaps even mythical. Atoll forests consist of a characteristic set of species that occur in the interior of the FSM's low atolls and can have a relative diversity of forest types. Often, these forests are a compact mixture of commonly utilized and agriculturally important trees, such as coconut, pandanus and breadfruit species present. On the larger atolls and some of the high islands, the forest type can also contain some

mangrove species as well, known in FSM as atoll inland mangroves (such as *Bruguira gymnorrhiza*), found behind the beach strand (Falanruw 2002), often in uninhabited areas or islands, making use of the fresh or brackish water lens toward the interior of islets. The beach strand is an association of shrub and herbacious species found along sandy and coralline coasts and intergrade into atoll forest. *Scaevola taccada, Tournefortia argentea, Sophora tomentosa* are generally present as shrubs in the outer fringe on sandy beaches with *Pemphis acidula* occurring where the substrate is more solid. Tree species occurring toward the interior of the complex commonly include *Guettarda speciosa, Cordia subcordata, Hernandia sonora, Pisonia grandis, Calophyllum inophyllum* and sometimes *Casuarina litorea* (*equisetifolia*) (TNC 2003). Taken together, the atoll forest – beach strand complex that are found mainly on the atoll islands of the FSM and in narrow bands along coasts of the high islands in Pohnpei, Kosrae, Chuuk and Yap are extremely important ecosystems. Although ubiquitous and widespread throughout the federation – they characterize the popular notion of tropical vegetation in the Pacific (Balcik et al. 2009) – the total area of these systems is relatively small. Yet this belies their importance not only to the people who use and share these forests on the nearly 70 inhabited islands of the FSM (Nimea 2006), but perhaps moreso, less from an anthropogenic point of view, these ecosystems are also very important sites of seabird and sea turtle rookeries and also provide sites for coconut crab larvae to come ashore and develop (Falanruw 2002). Not inconsequentially, these are the best and final environments where the four species of turtle found in FSM are able to maintain their existence. Of all of the effects of climate change, the gradual immersion of these islands may prove to be the final blow to these prehistoric reptiles. Even where humans do not exist, our reach extends.

Limestone forests in the FSM are an extremely rare and unique form of atoll forest. More common in the Marianas and Palau, it occurs primarily only in FSM on the raised limestone islands of Fais and Satawal, in Yap (Falanruw 2002). Limestone forest grows on hard limestone substrates, sometimes with little soil except in crevices. This type of forest is dependant on the recycling of nutrients from leaf fall so does not regenerate well once the forest canopy is removed. It is a distinctive forest type with characteristic native and endemic species, and provides habitat for coconut crabs, giant clams and the provision of turtle

nesting beaches (TNC 2003). The Fais Limestone Forest is a particularly fragile and unique ecosystem and is in fact identified as one of the 130 Areas of Biodiversity Significance for the FSM, targeted for official protection.

1.3.4 Species diversity

Some of FSM's wild fauna and flora are relatively well researched, while others are not well known at all. Considerable work remains to be carried out. Several national and state level species assessments have been carried out, one of the more significant being the Areas of Biodiversity Significance exercise carried out by the national and state governments in 2002. In the 1980's, 1990s and in the 2000's various other assessments have been carried out as well, with the assistance of the New York Botanical Gardens, The Nature Conservancy, Reef Check International, the US Forest Service, the National Oceanic and Atmospheric Administration, Wild Aid, the United Nations, the David and Lucille Packard Foundation, amongst other international and regional partners. These include forestry assessments, rapid ecological assessments of the reefs, mangrove studies and coastal mapping and surveys. Important research initiatives by individuals, universities and Environmental NGOs have added to the knowledge base on FSM's biodiversity as well. Considerable data gaps remain however. The Conservation Targeting exercise carried out by the nation in 2002 as part of the identification of 130 ABS in FSM was particularly concerned with a lack of species data available: "Although many species targets are not imminently endangered, distribution and viability data were so poor for some of them that the teams could not identify enough occurrences to meet the conservation goals. These species will require further biological monitoring to determine their spatial distribution, population, and overall viability. A few other terrestrial species are so rare and endangered, or have ranges so limited that only one, or in some cases, no occurrences could be confidently identified. *If these conservation targets are to survive and remain viable in the FSM, immediate research and monitoring on them is needed."*

Sources: CSP, KCSO, YapCAP, CCS, 2005-2007; TNC 2003; FSM 2009.

Flora and fauna in terrestrial and freshwater wetlands

Species diversity in the FSM is the nation's living wealth (Falanruw 2001). Species endemism is high, a direct result of the isolation of the islands to one another and to other landmasses in the greater Micronesian region (NBSAP 2001). Diversity for terrestrial biota – e.g. plants - is actually quite high (NBSAP 2001) for such a small collective land mass. For example, there are over 1,239 species of ferns and flowering plants in the FSM (Falanruw 2002), with at least 782 species (63%) being native (Fosberg et al 1979, 1982 and 1987) (**Table 7**), and of those, nearly 80% likely to be endemic (Balick 2009). The Micronesian high island floras are comprised of elements from the Indo-Malaysian region, with relationships to the south as well as to the west (Asutralia, New Guinea, and Melanesia). In addition, the low islands and coastal areas of the high islands are populated by elements of the pantropical and Indo-Pacific strand floras (Mueller-Dombois and Fosberg 1998). Because of this diversity of floristic elements coupled with endemism, the Caroline high islands play a key role in understanding Pacific island biogeography (Balick et al. 2009). When considered collectively, the Micronesia biota comprises a remarkable yet understudied assemblage of endemic and rare species (Balick et al. 2009). For example,

Pohnpei is an island with a rate of plant endemism that is comparable to or exceeds that of most of the major biodiversity hotspots in the world (Balick et al. 2009). Meyers et al. (2000) calculated the top eight conservation hotspots using factors including an "endemic plants/area ratio" based on the number of endemic plant species per 100 km^2 , listing the following areas from highest to lowest: Eastern Arc and Coastal Forests of Tanzania/Kenya; Philippines; Caribbean; Western Ghats/Sri Lanka; Madagascar; Sundaland; Brazil's Atlantic Forest; and Indo-Burma. It has been calculated that Pohnpei Island has a ratio that would make it recognized as the fourth highest conservation hotspot in the world, and be worthy of inclusion into what Meyers et al. described as the world's "hottest hot spots" (Balick et al. 2009). With more systematic exploration of not only Pohnpei, but also the other high islands and atolls of the FSM, including the niche habitats, the ratio of endemics to area will likely increase.

TABLE 8: Plant species diversity in the FSM

Island	Ferns	Monocots	Dicots
	(both native & introduced species)		
Yap	47	208	363
Chuuk	48	156	266
Pohnpei	110	228	391
Kosrae	74	172	172
Total number of species	279	764	1,192

Source: Falanruw, 2002

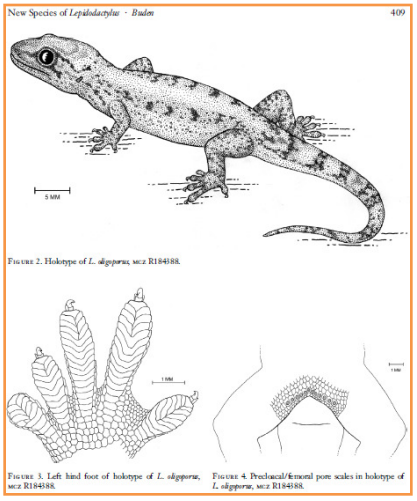
Photos by Carlos Ciaghini

Freshwater species diversity is also quite unique and fragile and yet data remains limited. Several types of molluscs, crustaceans and fish exist, as well as other vertabrates, such as the river eels in the rivers of Pohnpei and Kosrae, but further documentation is certainly required. Unlike some of the forests and plants within the freshwater systems of the FSM, the species diversity of animals in these systems is not as well documented. Of the identified species, the two species of Pohnpei River goby have been identifed and are considered endemic as well as targeted for protected status (TNC 2003). There is also at least one species of freshwater crab, found in a remote watershed riverine system on the unroaded and undeveloped western coast of Kosrae[61]. The native freshwater species that live in the rivers and streams are key indicators of overall riparian health in the FSM, and where they exist in significant

[61] In a place known as Wiyu, in 2006, the author of this report did discover a small crab, light colored, with red markings on the back in the middle reaches of the river, but was not able to phototgraph it before it scampered away and out of reach. According to Hamlet Jim, the guide who lives at the base of the river, in the estuary zone, the author was the first white man to visit the area in the guide's lifetime, so remote and unknown (even to Kosraeans) is the watershed.

abundance, rivers can be considered unpolluted, with relatively little anthropogenic alteration to the landscape. Apart from these, there are twenty-four species of reptiles (e.g., skinks and geckos) and amphibians, including four endemics, with one endemic genus, found in the Caroline Islands (Dahl 1986). The least understood group of vertebrates in the FSM are the reptiles and amphibians. Studies of the reptiles of Micronesia are incomplete, and it is likely that there will be additional records as well as new species (Buden and Edward 2001, Falanruw 1975) in future studies.

Endemicity among vertebrates is appears likely to by high, particularly among the freshwater fishes and reptiles. For example, a recent new species in the Group II complex of the gekkonid lizard genus *Lepidodactylus* Fitzinger was described based on collected material from Namoluk Atoll, Mortlock Islands, an outer island goup in Chuuk, *Lepidodactylus oligoporus* Buden, n. sp (Buden 2006). The gekkonid genus *Lepidodactylus* Fitzinger includes 31 species (Uetz et al. 2005) that for the most part are distributed from Southeast Asia southward and eastward to the Indo-Australian Archipelago and Oceania (Bauer and Henle 1994, Ota et al. 2000, Zug et al. 2003). The species each have rather limited distributions and are often found on only one or a few small island groups (Ota et al. 1995, 2000, Zug et al. 2003).



Source: Dr. Don Buden, 2009

The tropical moist cloud forests of Pohnpei and Kosrae are also home to 27 species of land snails, representing 74 percent of the total number of species recorded for that island (Raynor 1993), and a considerable percentage of the total for the entire nation. Among land snails there appears to by high endemism (Falanruw 2002). It should be noted that while there has been some work done on the terrestrial invertebrates of the FSM, reports are scattered, and mostly located outside of the FSM. There are indications however that the invertebrate fauna of the FSM is rich and interesting, for example, apart from the 27 species of land snails found in Pohnpei and Kosrae, the forests of Chuuk are host to a giant millipede that seems to occur only in Chuuk (Buden, 2004), and Palau in Micronesia and fireflies (beetles) occur on Yap (Falanruw, 2002).

Overall in FSM there is a dearth of terrestrial mammals, with the notable exception of the endemic flying fox populations, with six distinct endemic species of flying fox (Genus *Pteropus*, also known as fruit bats). The fruit bats, or flying foxes (which are actually considered primates), were the only mammals to cross the ocean divide of thousands of kilometers in Oceana (Polynesia, Melanesia and Micronesia) (BBC 2009). However, very little is known about their habitat needs or current population condition and trends. Since data on flying foxes is so sparse, the primary indicator of this keystone species health has been to rely on roosting sites within healthy forest – both atoll and upland forests - as a surrogate indicator for population occurrence and viability. Clearly, more research is needed on the biology, current status, and recommended actions for these keystone species so vital to overall native forest health (TNC 2003). In the meantime, the island's fruit bats (*Pteropus marianas*, *P. molosinnus*, *P.*

insularis, *P. phaeocephalus*), the latter three being restricted to the Carolines, are all clearly threatened by habitat loss and commercial hunting for export to Guam (WWF 2009). Like the fruit bats, a number of the terrestrial species are currently at risk **(Table 8)** and in need of further observation and research, and importantly, protection (TNC 2003). Other mammals have been introduced including at least three species of rats: the 'Polynesian' rat [*Rattus exulans]* the roof rat [*R. rattus*] and the Norway rat [*R. norvegicus*], mice *[Mus musculus]* dogs, cats, pigs, goats, a few cattle which have not generally persisted, and on Pohnpei, the introduced Philippine deer [*Cervus mariannus]* (Wiles et al. 1999). Goats, pigs and deer have all become feral and on Pohnpei and Kosrae have become part of the landscape in the upland forests (Falanruw 2002), where they are hunted extensively as a highly prized local source of protein[62].

Odanata: Indicators of Diversity

Over the world, forests provide diverse habitats for a range of organisms, including dragonflies and other animals that at a first sight seem not to be interdependent with forests. Dragonfy larvae are sometimes found amongst tree roots. Dragonflies are highly dependent on forest cover and composition, and this is true from the boreal forests to the tropics. Native forests in particular are essential for the maintenance of this species, which acts as a top predator. Forests are feeding places for many dragonflies, and movements between ponds and forests are therefore continuous. Roads through forests have suprisingly high mortality rates for dragonflies for example, not only due to fragmentation of these landscape elements, but from collision with vehicles. Dragonflies are therefore good indicators of forest structure and composition of tropical forests (Clausnitzer 2003), The photos here are of a Pohnpei odonate that is a damselfly (close relative of dragonflies--same order, Odonata). Scientific name *Ischnura aurora*; almost certainly a male based on its bright coloration. The red dragonfly is from Yap and is a male *Neurothemis terminata*.

Sources: Rivera, 2006; Buden, 2010

Most insecst have been incompletely surveyed, though there are a host of different species of insects, including spiders, flies, grasshoppers, butterflies, bees, dragonflies, beetles, mosquitos, and a myriad of others that have been documented to some extent. These insects serve various purposes, and most often provide a food source for many of the brids, reptiles, freshwater fish and amphibians on the islands, but more subtly, may also be examples of a trophic cascade in an ecosystem (Polis et al. 2000; Rivera 2006)[63]. Many of the insects were introduced as biological control agents, particularly various types of beetles – e.g. coconut rhinoceros beetle, mealybugs, lady beetles - that were used to control scales or other pests that damage important crops such as bananas, coconut, breadfruit and

[62] In Pohnpei, it is the Sambar deer that are present and hunted. In Kosrae, it is the feral pigs.

[63] An occurrence in nature first explicitely proposed by the famed Naturalist, Charles Darwin; the premise is that one seemingly unrelated organism has an effect on another – e.g. a cat which eats mice that in turn destroy nests of bees, which in turn eat the nectar of a certain plant or flower, so that the cat actually has an indirect effect on the number of flowers in an area (Rivera 2006).

other important staple crops (Schreiner 1989). Some studies have been undertaken. There have been some site-specific studies done on skinks, butterflies, geckos, millipedes[64], dragonflies and others indicating several endemic species are point endemics, restricted to extremely small areas within a single forest (TNC 2003) or other terrestrial system. Examples are the Arno skink (*Emoia arnoensis*), thus far recorded only in the Marshall Islands, Kosrae, and Nauru, and the Giant Micronesian gecko (*Perochirus scutellatus*), believed endemic to the FSM's outer islands, and has been found on only two atolls at opposite ends of the country (TNC 2003), and a recently discovered new species of blind snake in Yap (Buden 2009).

TABLE 9: Terrestrial Species with limited or no occurences confidently identified[65]

Specied with limited occurrences identified	Species with no occurrences identified
Arno skink (*Emoia arnoensis arnoensis*)	Caroline Island ground dove (*Gallicolumba kubaryi*)
Cicabird (*Coracina tenuirostris*)	Chuuk flying fox (*Pteropus insularis*)
Kosrae flying fox (*Pteropus ualnus*)	Chuuk greater white-eye (*Rukia rukia*)
Micronesian swiftlet (*Collocalia inquieta*)	Chuuk monarch (*Metabolus rugensis*)
Pohnpei flying fox (*Pteropus molossinus*)	Chuuk poison tree (*Semecarpus kraemeri*)
Pohnpei Island skink (*Emioa ponapea*)	Giant Micronesian gecko (*Perochirus scutellatus*)
Caroline sheath-tailed bat (*Emballoneura semicaudata*)	Gray duck (*Anas superciliosus*)
Pohnpei river goby (*Sicyopterus eudentatus*)	Micronesian pigeon (*Ducula oceanica*)
	Mortlocks flying fox (*Pteropus phaeocephalus*)
	Pohnpei mountain starling (*Aplonis pelzelni*)
	Pohnpei short-eared owl (*Asio flammeus ponapensis*)
	Pohnpei tree snails (*partula guamensis and P. emersoni*)

Source: The Nature Conservancy, A Blueprint for Conserving the Biodiversity of the FSM, 2002.

The greatest proportion of the FSM's terrestrial vertebrates is birds. The avifauna of the islands of the FSM is the primary and most readily visible terrestrial species, clear indicators of overall ecosystem health. They include a relatively large number of endemic species, adapted specifically to the unique and threatened biomes in which they live. However, if the avifauna are an indication of terrestrial ecosystem health, then there are some troubling signs: two species are extinct, five more are considered endangered, and six more near-threatened (Hezel 2002). Indeed, due to the limited range

[64] The spirobolidan millipede *Acladocricus setigerus* (Silvestri, 1897) grows to at least 155 mm long and is so far known only from Chuuk Islands, Micronesia. It occurs mainly in well-shaded habitats, usually on the forest floor and on tree trunks (Buden et al. 2004).

[65] This information is taken from a two-year coordinated process that was undertaken throughout the FSM and does not mean that the 'species with no occurrences identified' are extinct, but that these species are thought to exist, but are more clearly increasingly rare and endangered, or have ranges so limited as to be nearly invisible. These species will require further biological monitoring to determine their spatial distribution, population, and overall viability. *If these conservation targets are to survive and remain viable in the FSM, immediate research and monitoring on them is needed* (TNC 2003).

and fragility of the ecosystems in which they survive, most of the endemic bird populations of the FSM are threatened simply by situation and circumstance (**Table 9**). Many of these endemic avian species (nearly 50%) are found within the range of the upland forests.

TABLE 10: Endemic birds of the FSM and status

Name	Status
• Kosrae Crake (*Porzana monasa*)	Extinct
• Kosrae Starling (*Aplonis corvina*)	Extinct
• Carolines Ground Dove (Gallicolumba kubaryi)	Vulnerable
• Micronesian Honeyeater (*Myzomela rubratra)*	NA
• Micronesian Kingfisher (*Todiramphus cinnamominus)*	NA
• Truk Monarch *(Metabolus rugensis)*	Endangered
• Yap Monarch (*Monarcha godeffroyi)*	Near-threatened
• Carolines White-eye (*Zosterops semperi)*	NA
• Yap White-eye (*Zosterops hypolais)*	Near-threatened
• Grey White-eye (*Zosterops cinereus)*	NA
• Yap Rukia (*)*	Near-threatened
• Truk Greater White-eye (*Rukia ruki)*	Critically endangered
• Long-billed White-eye (*Rukia longirostra)*	Near-threatened
• Golden White-eye (*Cleptornis marchei)*	Critically endangered
• Giant White-eye (*Megazosterops palauensis)*	Near-threatened
• Micronesian Starling (*Aplonis opaca)*	NA
• Pohnpei Starling (*Aplonis pelzelni)*	Critically endangered (possibly extinct)
• Blue-faced Parrotfinch (*Erythrura trichroa*)	NA
• Short-eared Owl (*Asio flammeus ponapensis*)	Critically endangered
• Pohnpei Lorikeet (*Trichoglossus rubiginosus*)	NA
• Micronesian Imperial Pigeon (*Ducula oceanica*)	Near-threatened

Source: Birdlife International, 2009.

As such, a number of Micronesia's birds are declining in numbers and becoming rare (Buden 2000). From surveys conducted in 1983 and 1994, a reduction in total birds per observation station for 18 native resident land birds, ranged from 67 - 78% in each of six major elevation zones (Falanruw 2002). Three species from the FSM are included in the U.S. Endangered species list: the nightingale reed warbler (Chuuk, and Woleai, and Lamotrek atolls in Yap state and Pohnpei), the Pohnpei Greater White-eye endemic to Pohnpei, and the Pohnpei mountain starling. Candidate endangered species include the resident race of Short-eared owl on Pohnpei, the Truk Monarch, the Truk Greater White-eye and the Truk subspecies of the Micronesian Pigeon. The Pohnpei Mountain Starling is on the verge of extinction (Engbring et al. 1990, Buden 1996). Several other species are recently extinct including the Kosrae rail and Kosrae Mountain Starling (Falanruw 2002). In total eighteen restricted-range species of bird occur in the Carolines (Statterfield et al. 1998). This out of 60 native land and wetland species, and a total of 261 species of birds reported for FSM (**Table 11**). Of particular interest is the Pohnpei short-eared owl. Little is known about the very rare Pohnpei shorteared owl (*Asio flammeus var. ponapensis*), a Pohnpei endemic subspecies that inhabits savannas. Lacking specific population data, savanna has been used as a surrogate indicator to map populations. Serious concerns exist for the stability of the owl population on Pohnpei. Immediate work is needed to understand the biology, population status, viability, and threats to this species (TNC 2003). A variety of doves and pigeons are also present throughout the FSM. The Micronesian pigeon is one species in particular that is quite threatened, as it is a favorite food for islanders, and is often hunted year-round, though there are existing seasonal hunting laws. Entirely, the bird populations of the FSM are not steady, particularly for the native endemic species[66]. Predators such as rats and especially cats are a constant threat. Anthropogenic alteration of the landscape – particularly in the uplands and the savannas – further erode the viability of many of the species. The FSM takes serious and strenous efforts to ensure that other invasives, such as the Brown tree snake, which has been partially responsible for the decimated native bird populations in Guam and to a lesser degree in the Marianas Islands, do not enter its borders (Engleberger 2009). But what is clearly needed in FSM is a focus on the internal anthropogenic threats that are mounting to native bird populations.

[66] Each State of the FSM has one or more endemic birds. They include the Dusky White-eye of Kosrae and Pohnpei, The Pohnpei Lory, the Pohnpei Greater White-eye, The Pohnpei Flycatcher, The Pohnpei Mountain Starling, the Caroline Islands Ground-Dove on Chuuk and Pohnpei, the Truk Greater White-eye, the Oceanic Flycatcher, the Yap Monarch and the Yap Greater White-eye (Falanruw 2002).

TABLE 11: Categories of birds recorded for the FSM

Island	Native land & wetland residents	Resident seabirds	Non-resident seabirds	Shorebirds & migrants	Introduced birds
Kosrae	10	5	9	16	2
Pohnpei	20	11	8	20	3
Chuuk	17	11	10	33	2
Yap	13	6	12	50	3
Total	60	33	39	119	10

Source: Falanruw 2002, Engbring at al. 1990.


Endemic Pohnpei Lory

Flora and fauna in coastal and marine ecosystems

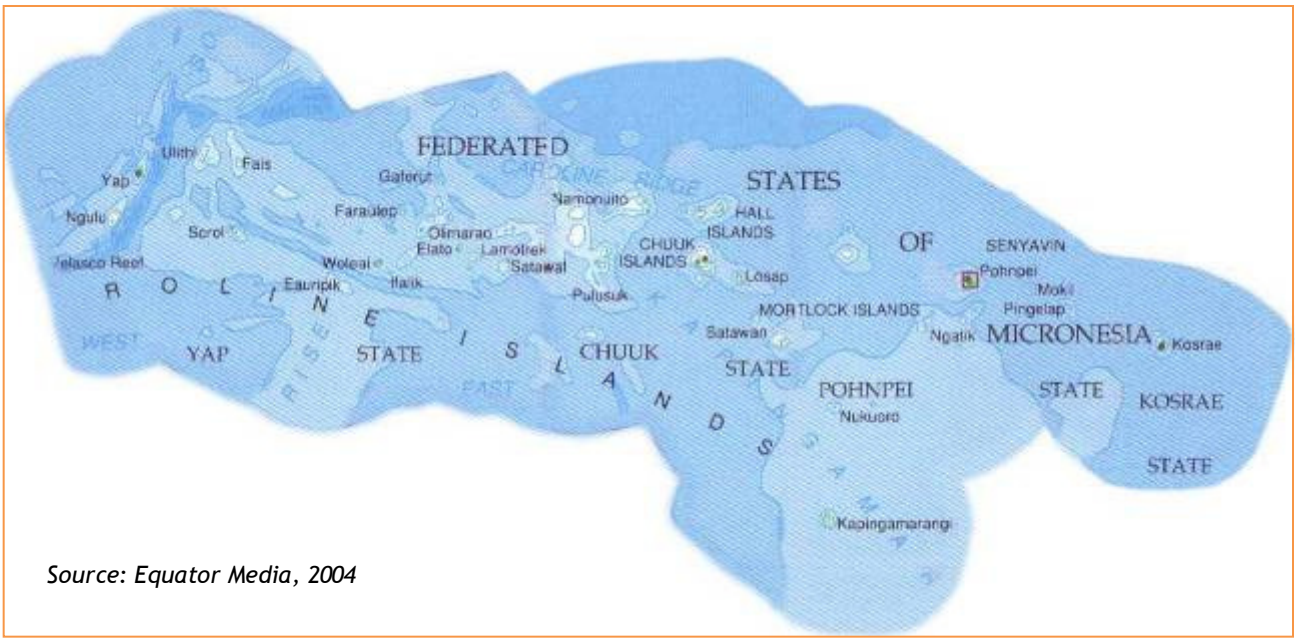
The coastal and marine fauna are also rather high in diversity, with more than 1,100 species of fish, 350 species of coral, a multitude of invertabrates and cetaceans that include lobsters, crabs, molluscs, clams and thousands of species of sponges and other creatures that inhabit the vast waters (**Figure 12**) of the FSM (CSP, NOAA, 2008). Crustose coralline algae are also abundant on the reefs (Birkeland et al. 2007). Its complex reef systems are a result of its proximity to the nutrient rich currents of the North Pacific Ocean, the Indonesian Sea and the Philippine Sea, movng toward the far western end of the Caroline Island chain in Palau, where the richest marine biodiversity in the world is found. Studies of marine mammals in the FSM have not been carried out and distribution records are scanty (Eldredge 1991), but it is known that there are a number of species of whales and dolphins within the FSM and a dugong, *Dugong dugong* was killed in Yap about a generation ago (Falanruw, 2002). Also, species in FSM marine and coastal waters contain a multitude of small and large pelagic and migratory fishes such as sardines, scads, hering, free-swimming planktonic crustacea , rainbow runners, big-eye, skipjack, yellowfin and a host of other tuna and billfish species that feed on the rich zooplankton and phytoplankton contained within the Pacific ocean (Dalzell 1992). As stated, the tuna fish stocks in particular are of monumental consequence as perhaps the most valuable resource that the FSM relies upon and exploits for commercial gain (NORMA 2002). There are also four species of turtles that come ashore to nest on the beaches (Falanruw 2002). Among these organisms are more than 100 species of bony fishes and shellfish that are important in the commercial food fishery as well (CSP, 2006)[67]. Several species of sea snakes and a diverse array of coral and reef associated organisms, including over 75 species of common fishes


Photos by Carlos Cianghini and Katrina Adams

[67] For example, in Pohnpei alone, between1969 and 1984 the average commercial harvest for trochus was 60 tonnes per year (Martin Mix, 2010).

are found in association with the prolific coral reefs. Genetic diversity within coastal habitats is believed to be high, and of possible economic value, but this aspect has not been investigated adequately as yet (CCNC 1997, NBSAP 2001). Periodic strong currents in FSM's waters also provide a wealth of current-borne zooplankton, which supports an inordinate number of plankton-feeding reef fishes, mostly found in the barrier reef channels and passeges coming out of the many vast lagoons in the federation (CSP 2006). These sites exhibit fish communities that are some of the richest in terms of diversity, with up to 171 species per site (CSP 2006).

FIGURE 11: Reef and ocean area of the FSM highlighting coastal and marine species range



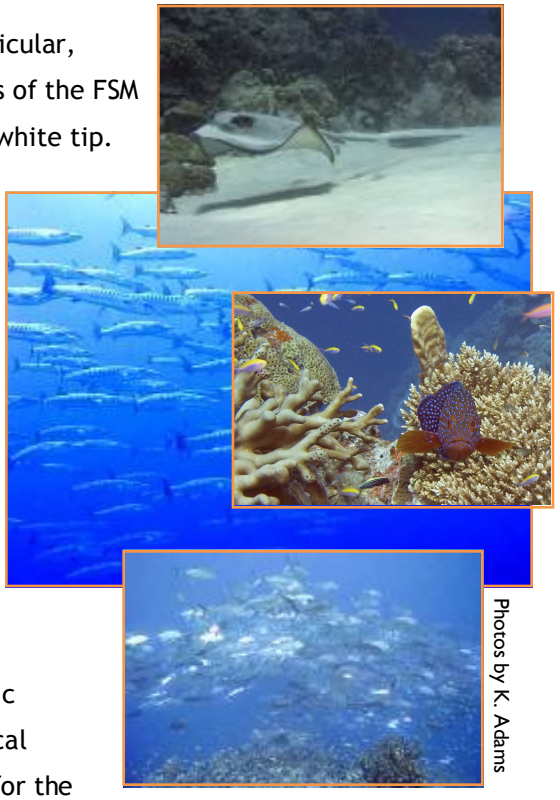
Source: Equator Media, 2004

Although comprehensive data is limited, as a general statement, the majority of the fish fauna of the FSM region consists of relatively wide-ranging species associated with coral reefs and intermingled habitats. The primary near-shore marine species are: gobies (*Gobiidae*); wrasses (*Labridae*); damselfishes (*Pomacentridae*); groupers (*Serranidae*); butterflyfishes (*Chaetodontidae*); surgeonfishes (*Acanthuridae*); parrotfishes (*Scaridae*); moray eels (*Muraenidae*); blennies (*Blenniidae*); squirrelfishes (*Holocentridae*); and cardinalfishes (*Apogonidae*). These families collectively account for approximately 60 percent of the total reef fish fauna (CSP 2006). In total reef-associated fish comprise 873 of the 1,125 marine fish species recorded for the FSM.

In terms of overharvest of many locally important species, diversity may be waning. As an example, in Kosrae, a Rapid Ecological Assessment conducted in 2006 indicated that important species of groupers, jacks, trevalleys, snappers, emperor, sweet lips and parrotfish were absent compared to surveys conducted in 1986. Yet there were also more than 71 new records of fish species seen throughout the

survey that were not documented in 1986. There were a few humphead wrasse (*Cheilinus undulatus*) recorded, and very few bumphead parrotfish (*Bolbometopon muricatum*), both of which are important species of the reef, with a single giant bumphead parrot fish accounting for major sand deposits. Again utilizing Kosrae merely as a representative example, there were 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.

As for the larger animals of the sea, the sharks and the rays in particular, taxonomic data is not complete. The reefs around the main islands of the FSM are inhabited by several species of Gray reef sharks, black tip and white tip. Other common sharks are the Hammerhead, as well as the less common Tiger shark. Around the distant atoll islands where the waters are deeper and colder, there are also Mako and Great whites that hunt around the reefs. Eagle rays are a common figure in the near-shore marine areas, as are various species of Sting rays, and the signature Manta rays are promonent in the channels and reef passes of both Pohnpei and Yap, attracting a substantial chunk of the local tourist industry for both islands, where divers go to see families of Manta feed on the mix of land-based and oceanic nutrients as they mix in the incoming tides.



Photos by K. Adams

In terms of the corals and the reefs, the three key biotic and abiotic categories of water quality, benthic habitat and associated biological community structures in the FSM are all prolific. Again, the data for the entire FSM reach and its myriad coastal and marine ecosystems is something that requires further consideration and work. In this vien, a primary conclusion drawn from recent and ongoing reef assessments throughout the U.S. and Pacific territories[68] concludes that current monitoring activities and the present resources allocated to conducting them are inadequate to provide the information needed by for decision-making at local and national levels. As such, there is still a critical need to develop robust monitoring strategies, allocate resources and implement field studies (NOAA 2008). As a final note on the existing health and diversity and coastal and marine species, it is important to again reference the implications of global impacts from climate change (as will be discused in further detail below). Global climate change presents urgent challenges for coral reef ecosystem management at the broadest spatial and longest temporal scales. Remedies for global climate change are far beyond measures that can be implemented by local management and require bold actions on an international

[68] FSM is one of the Freely Associated States with the U.S., along with Palau and the Marshals. Other U.S. Pacific territories are Guam, Hawaii, and the Mariannas Islands.

scale to affect change (NOAA 2008), without which reef species diversity can be expected to continue to decline (NOAA 2008).

1.3.5 Agricultural biodiversity

Agroforests and the practice of agroforestry in all its forms is a huge component of the FSM lifestyle and landscape. In sum, over all of the islands of the FSM, 35% of the landscape is devoted to agroforest (Falanruw 2002). These forests exhibit great plant diversity (Adam, Balick and Lee 2003) and many varieties and cultivars for the staple food crops in particular, including more than 55 banana, 133 breadfruit and 171 yam cultivar names for Pohnpei alone (Raynor 1991). Almost all production is through the agroforestry system, which consists of multi-storied gardens of trees and shrubs grown among annual and perennial crops and, often, domestic animals (Merlin 1992). Some of the more rural communities – on both the high islands and atolls - continue to depend upon the agrobiodiversity – as well as all of the diversity around them. **Table 12** below exhibits a representative sample (from Pohnpei) of the high natural diversity surrounding the people of the FSM and their reliance upon it for daily needs. This is quite often referred to as subsistence agriculture and is recognized by both the FSM national government and many international organizations as a vital and efficient part of the economy (ADB 1995); critical in supporting a large portion of the populous whose very survival depends upon these systems of agro-diversity (FSM HIES 2008). These systems have been maintained for hundreds of years through every generation since the people of the FSM arrived in the Caroline Islands, with the commensurate traditional knowledge carefully developed through hypothesis-driven experimentation. However, this is changing rapidly, as traditional values are replaced with contemporary lifestyle and beliefs (Balick et al. 2009). There are a few current commercial fruit and vegetable production units in the FSM, with most no larger than 20 acres in size. Subsistence production is based mainly on shifting cultivation agroforestry systems. The agroforestry takes the form of garden areas for root-crops (e.g., taro, yam) and other vegetable production, interspersed with a high proportion of food trees, particularly varieties of coconut and breadfruit. Banana is central and probably the most important food crop (Engleberger 2010, pers. comm.) There is a tremendous diversity of pandanus as well on the outer atolls (Engleberger 2010, pers. comm.) Mango, guava, pineapple, and a number of banana and papaya varieties are common with additions of varieties of citrus species (e.g., tangerines, limes, sweet and Valencia oranges). Integrated with the mix of fruit and other food crops is an understory of plants and shrubs used for a number of other local purposes, often medicinal (Balick et al. 2009). Increasingly, FSM also has a range of vegetables grown, including both temperate and tropical species that are cultivated throughout the country. Among these are introduced tomatoe, sweet potato, gourds, bell peppers, eggplant, squash, pumpkin, cabbage, cucumber and other vegetables (FSM DEA 2007).

TABLE 12: Summary of the Mand community traditional food list

Food list items	Number of food species
Starchy staples	
Arrowroot	1
Banana/cultivars	26
Breadfruit/cultivars	15
Jackfruit	1
Sweet potato/cultivars	6
Tapioca/cultivars	9
Taro, *Alocasia*/cultivars	2
Taro, *Colocasia*/cultivars	5
Taro, *Cyrtospermal*/cultivars	12
Taro, *Xanthosomal*/cultivars	2
Yam/cultivars	42
Palms	
Coconut/cultivar, Cocos nucifera	6
Mountain palm, Clinostigma ponapensis	1
Oil palm, Elaesis guineensis	1
Palm, Ptychosperma spp.	1
Nuts	
Chestnut	1
Indian almond	1
Red bead	1
Fruits (excluding bananas and pandanus)	23
Pandanus/cultivars	13
Citrus/cultivars	3
Vegetables	25
Herbs (basil, garlic vine, lemon grass)	3
Spice (pepper, ginger, turmeric)	3
Local drink: native cinnamon	1
Local drink: hibiscus flower	1
Local drink: *sakau* cultivars	2
Fish	127
Shellfish	13
Crab	4
Shrimp	2
Sea cucumber	2
Turtle	2
Other seafood (octopus, squid, lobster)	3
Bird	15
Pig and other animal (carabao, cow, deer, dog,	6
Total	**381**

Photo by Island Food Community of Pohnpei

Source: Indigenous Peoples' Food Systems - Pohnpei, 2007

*Some foods (e.g. freshwater eel and several types of sea cucumber) eaten by some Pohnpeians, but not by Mand people, were removed from the list.

FSM can certainly be considered a world center for breadfruit and giant swamp taro cultivars. But there are other areas of food diversity as well. FSM's spices are well-known. At present there is at least one indigenous species of Cinnamon tree, of which the wild variety occurs in the natural tropical rain forests of Pohnpei. Pohnpei also has at least one species of pepper spice, which is regarded as the best in the world; throughout FSM there are also several indigenous varieties of *Piper betle* (betel leaf); several species of nutmeg (*Myristica*); a few species of chilli; and at least one species of wild ginger. Of course the local crop known as sakau (*Piper methysticum*) is also present and exhibits a rich genetic diversity. Small plantation agriculture continues to play an important role in FSM's economy, as does larger, commercial farming – e.g. coconut, sakau, pepper spice, citrus, banana – and research at research institutions[69] and selection through the years has resulted in considerable diversification of crops. The relevant research institutes have now also produced high-yielding varieties of citrus and banana in particular that are resistant to pests and disease. These are important crops to the local economies where they are grown. In recent years the results of a "Grow Low" campaign[70] to move sakau production from the upland forest into the lowland agricultural zone has resulted in a significantly lower annual deforestation rate on Pohnpei (Balick et al. 2009) in particular. Sakau is also grown on the island of Kosrae, and more recently on Fefan Island in Chuuk, as it is – alongside betel nut – the largest commercial crop in the FSM and thus comprises a major component of the local functioning economies and also brings in export revenue to the country. It took many years to develop the many varieties of traditional Micronesian food crops, and they are a valuable heritage (Falanruw 2002). In Micronesia, 79% of the native plants are endemic. So if one were to judge biodiversity hotspots by endemic plants per hundred square kilometers, Micronesia falls in the top 10 in the world (Balick 2010).

FSM: high endemism and usefulness of agrobiodiveristy

There's a species of endemic cinnamon tree only found on Pohnpei, FSM. People use it to treat back pain, making a tea out of it. Researchers from the New York Botanical Garden were puzzled by the widespread use of this tea because Pohnpei's cinnamon contains a cancer-causing agent called saffrol. Saffrol is also found in Sassafras tea. The research team were wondering why people were not getting tumors from drinking so much of this tea, and eventually found that the heat of the tea removed the harmful chemical from the cinnamon. The researchers have found that these sort of medicinal plants are growing all over the island and there's a lot of traditional knowledge about how to use them, but the problem is that the elders who have the knowledge don't share it. Globalization – things like video games and the draw of urban life – are chipping away at both the knowledge and subsequently the diversity of medicinal plants, as subsequent generations don't recognize them anymore, and they disappear. This is a loss for everyone. If all the world's plants were studied for their medicinal value, we could increase the number of pharmaceutical medicines available by tenfold.

Source: EarthSky, 2010

[69] The College of Micronesia has a dedicated Agricultural Research Station and Land Grant program, which was also instrumental in establishing the FSM Tissue Culture Center, which focuses on pest and disease resistant popular varieties of crops and introduction of additional staple foods.

[70] This campaign has been led by the Conservation Society of Pohnpei for nearly five years.

Farming systems and home gardens

Although sharing many characteristics of home gardens (Nair 2004), the FSM farming system is best classified as a "multistory tree garden" because it is not limited to the area immediately around the house compound but extends throughout the landscape (Raynor and Fownes 1991). Almost every household engages at least part-time in agricultural activity. Breadfruit, banana, giant swamp taro are the main components of the agrobiodiversity in the FSM. On the high islands at least, breadfruit is the principal component of indigenous agroforestry systems, and indigenous agroforestry is a dominant feature of the islands' landscape and culture, the result of more than two thousand years of development and refinement (Petersen 2006, Raynor 1994). Agroforests provide many products for subsistence, sale and social use, while maintaining permanent soil and canopy cover. This complex, sustainable system of land use – some agroforest areas have been in continuous production for a hundred years – integrates a wide array of plants cultivated or harvested for food, fuel, fiber, construction, materials, ornamentation, medicine, and so on (Raynor and Ragone 2009).

Based on the discovery of the high nutrient content related to their deep orange and yellow-colored flesh (Englberger 2003), Karat, the traditional infant food of Pohnpei, and other Pohnpei bananas have received a great deal of international attention (e.g., Augenspeig; Coghlin 2004; Die Welt 2004; IPGRI 2004; Kuhnlein 2004; NatraIngredients 2004; VN Express 2004). A series of studies have shown that Karat and other Pohnpei banana cultivars have the highest known levels of provitamin A carotenoid content in the world in bananas (Englberger et al. 2003). In one sample of Karat, the level of beta-carotene, the most important of the provitamin A carotenoids, was over a hundred times that in commercial banana samples analyzed in the United States and the United Kingdom. Related to this and its high cultural status on Pohnpei, Karat was named one of the "three shining stars of the traditional food galaxy" in a global literary review (Kuhnlein 2004) and was highlighted on a poster as one of 14 nutirent-rich indigenous foods selected from around the world (FAO and Kuhnlein 2004).

Englberger, Lorens, Levendusky, Daniells 2009; Lorens and Engleberger 2007.

A survey of 10 ha (on fifty-four randomly selected farms) documented 161 species (102 trees, shrubs, and crops and 59 uncultivated herbacious plants (Raynor 1989, Raynor and Fownes 1991). The number of tree, shrub, and crop species per farm ranged from 16 to 37, with an average of 26 species. Breadfruit (72 trees per ha) was cultivated on all 54 farms, while coconuts (92 trees per ha) occurred on 96 percent of the farms. Plantain and banana were found on 98 percent and 91 percent of farms, respectively. The dense stands of coconut trees are remnants of wide-scale plantings made for commercial copra production under colonial administrations (Bascom 1965, Petersen 2006). Twenty-eight breadfruit, thirty-eight yam, eighteen plantain, and six banana cultivars were found in the survey plots, showing the cultivar diversity is an important component in the biological diversity maintained and utilized in FSM agroforests (Raynor 1989, Raynor and Fownes 1991).

Finally on the subject of the staple breadfruit, it is also used as a major food source – along with wild varieties of taro – for the culturally important pig, especially during the main breadfruit season (Fownes and Raynor 1993). This multipurpose tree also provides timber for canoes and carvings, medicine, and a sticky latex for glue. The inner bark was once used to make women's clothing (Bascom 1965).

When discussing farming systems and agrobiodiversity in the FSM, one must mention the banana, which includes plantain. The diversity of bananas throughout the FSM is astonishing (Englberger et al. 2009). On the island of Pohnpei alone, Raynor (1991) listed 55 names of different cultivars. Banana is likely to be FSM's most widely used locally grown crop (Bascom 1965, Englberger 2003, Raynor 1991). While yam is the most important crop in the traditional prestige system and breadfruit is considered by many as the most highly valued food crop, both of these are seasonal crops. Bananas, on the other hand, are harvested throughout the year, consumed on a daily basis. Banana also has many nonfood uses (Englberger et al. 2009). The Micronesian diet, however, has changed significantly since World War II. Imported rice, flour, fatty meats, sugar, and many sweet and refined foods have increasingly replaced locally grown foods due to convenience, lifestyle changes, cost, status, government policies, food aid, and the shift from subsistence to market economy.

The tree fern (*Sphaeropteris nigricans*) is part of the extended agrobiodiversity landscape – its fronds are eaten as food and its trunk a durable wood for posts.

Taro is an all-important staple crop across the federation. Of the 24 giant swamp taro varieties (there are likely more as this is the assessment from Pohnpei Island only), they are essential to the survival of the people on the outer atolls of Pohnpei, Chuuk and Yap. In Yap the culture has developed a world-class tree garden taro patch system of permiculture. In 1976, these "agroforests" comprised some 26% of the island's vegetation. Altogether, Yap's system of food production incorporated landscape architecture from uplands into nearshore waters (Falanruw 1994) in a traditional form of "ecosystem management" (TNC 2003). Lastly and quite importantly, a great quantity of the species diversity in the agroforests is dedicated for health and medicinal purposes. For plant diversity, the intrinsic value is imeasurable, not only to the people of FSM, but also the world. Equally, the diversity of knowledge about the uses of the biota for human health is also immense. But like the fragile state of plant diversity in FSM, the ethnomedicinal[71] systems that for so many centuries has ensured the health of local people is now, with fewer knowedgeable practitioners, an endangered art and science (Balick et al. 2009). Ethnomedicine has great value not only in improving health care in this remote region of the world, but also in supporting conservation of the diversity of life in the forests (Balick et al. 2009) , showing that cultural diversity is positively proportional to environmental diversity.

[71] An excellent term gleaned from the outstanding book compiled and published in 2009, Ethnobotony of Pohnpei: Plants, People & Island Culture.

Agrobiodiversity in ex-situ conservation facilities

The Micronesia Plant Progation Research Center (MPPRC) was established in 2003 under the College of Micronesia Cooperative Research and Extension Program (USDA Land Grant Program) and is the main repository of crop germplasm. Located on the island of Kosrae, its functions cover exploration, evaluation, seed conservation, biotechnology and data management. There are several main objectives carried out by the top-notch facility: To improve and increase agricultural production in the FSM; rid plants of disease and control invasive species; lure overseas marketing opportunities for Kosrae and the other FSM States; and conducting advanced microbiology, tissue culturing, and genetic engineering of staple crops. The center has already successfully produced and distributed thousands of "elite" seedlings of banana, taro, and citrus, and with them established a conservation program (in tissue culture) to secure the safety of plant stock - known as germplasm - in case of natural calamities such as plant diseases, typhoons, ocean rise, or floods. The disease resistant crops have been popular with local farmers. They should also provide for superior and consistent agricultural exports to neighboring and overseas markets. MPPRC has also been active in developing resistance to a citrus canker sickness through cell level research. Other ongoing projects are tissue culture production of enhanced sakau and coconut seedlings, and collaboration with Yap to conserve several important Yam varieties, a staple food which is increasingly threatened due to sea level rise and other anthropogenic developments. The MPPRC is well equipped to conserve indigenous plant germplasm of crops and their wild relatives. In Pohnpei, there also exists an FSM Pilot Farm genebank collection for the preservation and conservation of plant genetic resources for banana, giant swamp taro and pandanus.

Sources: Verma, 2008; Wortel, 2003; Engleberger 2010.

1.4 Threats to FSM biodiversity

There are numerous serious threats to the nation's biodiversity (CCNC 1997). In the broadest terms the FSM currently faces an uprecedented conglomeration of different localized and global pressures which are pressing ever more diligently upon the unique and fragile biodversity of the federation. A quickening of the pace of everyday life, the conversion and deepening immersion into a market economy dependent upon outside inputs, and the movement toward extrapolated infrastructure construction are the trifecta of 21st Century life that form the triangle of sustained development facing the FSM today. Various reports and assessments have identified the primary threats to the structure of FSM's ecosystems and functioning biodiversity. As both environment and culture have always been important to the FSM in its historical development objectives and the federations' international relationships, there are a multitude of documents. This report will utilize the following national overarching documents, as they collectively address a comprehensive and authoritative milieu:

- The Climate Change National Communication - 1997
- The National Biodiversity Strategy and Action Plan - 2001
- The FSM Strategic Development Plan - 2003
- The Blueprint for Conserving the Biodiversity of the FSM - 2003
- The State of Coral Reefs in the Pacific Freely Associated States – 2008

The Constitution of the FSM – ratified in 1978 at the dawn of the federation's young nationhood – states from the start: "*we affirm our common wish to live together in peace and harmony, to preserve the heritage of the past, and to protect the promise of the future...to become the proud guardian of own islands, now and forever.*" As the founding paper for the FSM then, the themes of all subsequent major policy papers, development reports, international commitments and the like over the ensuing decades carry threads of the Constitution forward, the essence of harmony, respect and stewardship present. Comparing and assimilating the five primary documents listed above – all of which contain the aforementioned threads of sustainability vis-a-vis mounting local and global development prerogatives - the major threats to biodiversity, and causes of biodiversity loss, can be categorized as thus:

- Overexploitation of biological resources
- Habitat loss and deforestation
- Land degradation
- Climate change
- Pollution
- Spread of alien invasive species
- Infrastructure development and urbanization

These seven bio-security factors, as we shall call them, are all highly variable and are taken as a representative factor across the range of environmental disturbances noted and/or highlighted by the major national documents reviewed, most of which were prepared through a very broad, multi-stakeholder input process in the FSM at different points in time. These are the critical threats (TNC 2003) to the biodiversity of the FSM, in no particular order. As has been detailed in previous sections, the FSM has unique biodiversity with a high percentage of endemics among the nation's biota. This heritage is now threatened. Consequently, FSM can be considered within the top 10 conservation hot spots globally (Meyers et al. 2000), selected based on the number of endemic plant species per 100 km^2 and at least a 70% loss of their natural habitat. The main causes of biodiversity loss are highlighted below. The subsequent sections on forests, freshwater wetlands, coastal and marine systems and agricultural habitats provide greater detail on the more specific pressures relevant to each of these areas.

1.4.1 The main causes of FSM's biodiversity loss

- **Over exploitation of biological resources**

In the FSM, the pressure on the usage of the local terrestrial and marine resource base – bio-resources – is the single greatest threat to diversity, and cause for the decline in both forest cover, habitat for species loss of reef diversity, and nearshore and oceanic fish stocks. Overfishing and overhunting has

been identified as the most urgent and critical threat across marine and terrestrial ABS[72] in all states (TNC 2003). The combination of a shifting economy from subsistence to cash and the commensurate shifting economic class stratification that is creating a growing underclass of families in poverty (HIES 2008) have led citizens residing in Micronesia to become more exploitive of natural resources in order to survive (TNC 2003). Dynamiting coral reefs in Chuuk for fish, nighttime spear-fishing in Yap, clearing watersheds to plant sakau on Pohnpei, and cutting mangroves in Kosrae for firewood are all current examples. The people are the guardians of the land (the theme expressed in the founding document of the nation, the Constitution), but they are also its main despoilers (TNC 2003). For most, it is a matter of survival in a rapidly changing world around them. Yet the loss of populations among many plant and animal species has brought many to the verge of extinction. Particularly affected by unsustainable collection on the reefs are many finfish, shellfish and certain species of the giant clam (Tridacna gigas), which has been almost completely eliminated in some parts of the FSM (FSM 1999). Overhunting in the forests has a continuing negative impact on the Micronesian pigeon, which is listed as either threatened (IUCN 2008) or near-threatened (Birdlife 2009) by leading international science organizations. In the face of these threats, there is certainly a growing recognition among policy makers and the general public of the positive direct relationship between the health of the nation's natural heritage and biodiversity, and a sustainable economic future (NARSD 2006). Furthermore, as biodiversity is lost to uncontrolled and unsustainable resource extraction, traditional environmental and resource management systems can also be seen to be deteriorating at the same rate, often to the point of being entirely lost (CCNC 1997), almost like the extinction of a species or an ecosystem. At the same time, conventional western approaches to conservation - government management and enforcement of large-scale conservation areas - have been ineffective due to land and marine ownership patterns, the difficulties inherent to regulating activities in extremely remote locations, and the limited capacity of government natural resource agencies (FSM 2002; SPREP 1993; MicSem 2002)[73]. The challenge remains a struggle: an attempt to balance the forces of globalization, commercialization and homogenization with unique cultural and ecological wealth. Often, particularly in the context of the threats to biodiversity, they are pitted against eachother, with ecology losing to the dollar. On a final but important note for this section, it must also be noted that by all practical information available, the high seas are currently being fished at an unsustainable rate, with fisheries collapse of several migratory fish stocks – yellowfin tuna, bluefin tuna and bigeye tuna amongst them – imminent within the decade (Greenpeace 2009).

[72] Areas of Biological Significance; There are 130 identified in the FSM, as such due to their uniqueness, species endemism, and threat level to their continued viablity.

[73] Diversity often gets caught in the crosshares of the exact point – some might say gray area – of communal restrictions on resource harvest and the individualist mentality of capitalism.

Habitat loss and degradation

Habitat loss and degradation constitutes one of the most serious threats to terrestrial and coastal wild biodiversity in FSM. Some of the most acute problems in this regard have been fragmentation and loss of forests through clearing for road and commercial development or conversion to monoculture plantations, destruction through burn cultivation in the Yap dry forest ecoregion (TNC 2003, Falanruw 2002) and encroachment for cultivation of cash crops (mostly sakau) in the moist forest ecoregion of Pohnpei, Chuuk and Kosrae; ad hoc reclamation of wetlands; and landfills in wetland habitats--particularly in urban areas--for housing and commercial and industrial development (MoFE, 1999). This degradation has had serious impacts on both the natural environment as well as health and economic prosperity of the FSM's inhabitants and the nation as a whole (NARSD 2006).

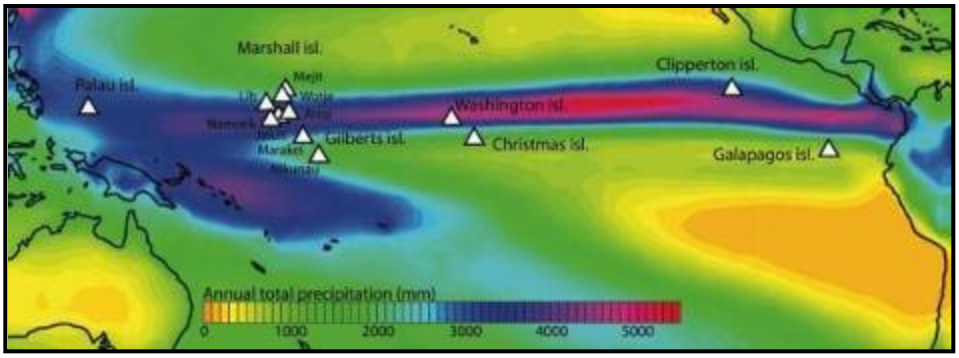
The degradation of freshwater wetlands has been severe throughout the federation, due mainly to deforestation (TNC 2003) and to siltation from unsustainable land use, salinity intrusion, and filling in of wetland areas for home and agricultural development. The traditional practice of converting wetland vegetation in swamp forests for taro cultivation has also affected wetlands within the moist ecoregion rainforests. Logging of swamp forests served to degrade many of the already fragmented *Terminalia carolinensis* forests, although where remnants to exist, a high biodiversity has continued to survive in them (YELA 2008). Habitat degradation has also been particularly acute in coastal ecosystems such as mangroves, lagoons, seagrass beds and estuaries, due to unsustainable fishing practices, over-exploitation of resources, pollution (often in the form of raw sewage), and unauthorized encroachment and land reclamation to convert coastal ecosystems to other uses (CCNC 1997). Many near shore coastal reefs are now severely degraded due to sand mining and coral dredging as well (Turak and DeVantier 2005).

Climate Change

Climate change is a massively serious threat facing the people and biodiversity of the FSM. Certainly, traditional subsistence crops are already severely in decline in most island atolls of the Federation, particularly the staples of taro and breadfruit (Englberger et al 2006), due to saltwater intrusion (TNC 2003). Salt water intrusion into water tables is also affecting water supplies in many areas, particularly atolls. Coastal erosion and the reality that displacement of whole islands and communities will occur are scenarios that the nation's leaders are already facing (FSM CEC 2008). The political leaders have made it

one of the top priorities and a regular discussion point nationally, regionally and internationally[74]. Regarding the effects of global warming, as a coastal nation, the FSM is particularly vulnerable to accelerated sea-level rise. And, because of the country's geographic location, future global warming holds the possibility of creating more frequent, intense, or longer-lasting El Nino droughts. The FSM is also affected by climate change phenomena over the short-term. Moderate to strong El Nino episodes create drought conditions across the nation. And, La Nina events bring heavier than normal rainfall, flooding, and wave and storm surge to the FSM's islands (CCNC 1997). Additionally, the FSM is within the heart of the Intertropical Convergence Zone, the rain band near the equator that determines the supply of freshwater to the islands and people of the FSM. The ITZ band is the most prominent rainfall feature on the planet (Sachs 2009). Research published recently indicates the band is moving northward[75] due to global warming. If the band continues to migrate, then some Pacific islands near the equator – even those that currently enjoy abundant rainfall – may be drier within decades and starved of freshwater by midcentury or sooner. The findings suggest that increasing greenhouse gases could potentially shift the primary band of precipitation in the tropics with profound implications for the societies and economies that depend on it.

FIGURE 12: Intertropical Convergence Zone



Source: Science Daily, 2009 (www.sciencedaily.com, World Bank Publications)

Conservative anticipated impacts from climate change include (FSM 1999): Tendency towards more frequent typhoons during local summer and fall seasons; Gradual increase in dry season in the western two-thirds on the FSM (Yap and Chuuk), especially December-April, with concomitant fire hazards; Projected accelerated sea level rise of 0.15 (minimum) to 0.95 meters (maximum) by 2100. Under the higher estimates of sea level rise, many coral atoll islands in the FSM may become uninhabitable to humans and natural terrestrial ecological systems. Climate change induced sea-level rise is likely to have significant impacts to marine biodiversity (Buddemeier 1993; Wilkinson 1999) — effecting turtle nesting beaches, low-lying seabird nesting areas, and mangrove forests (TNC 2003).

[74] Climate change is now a standard agenda item for the FSM Chief Executive Council meetings. The CEC is a regular meeting – once every four to six months – between each of the four State Governors and the President and Vice President.

[75] In the July 2009 Issue of Nature Geoscience.

Pollution

Pollution in inland freshwater and coastal wetlands (i.e. lagoons, estuaries) and associated marshes has been severe, due to contamination with sewage and dumping of solid and untreated industrial wastes. This has made many aquatic habitats unusable to freshwater species, including several endemics that need clean, clear water. Beach ecosystems area also polluted when used as dumping grounds for solid waste due to the paucity of land for safe disposal. Pollution of lagoons and estuaries has in turn severely affected the fishery industry in several lagoons. Release of ballast water and waste oil and tar from ships have added to coastal pollution. Water Pollution from the improper disposal of both solid and liquid wastes, mainly from domestic sources is a serious threat to coastal and marine inshore areas. This is especially true for population centers where people live in over-crowded conditions with only minimal sewage treatment. Existing sewage systems are often poorly constructed and inadequate for the population in the fast-growing district centers; coliform contamination of surface and ground waters is common (Detay et. al. 1989; SPREP 1993).

FIGURE 13: Water pollution warning

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Pohnpei's Recreational Sites Advisory
SEPTEMBER 2009

The Pohnpei Environmental Protection Agency (EPA) wishes to inform the general public that during the month of September 2009, twenty one (21) recreational sites around Pohnpei were tested for both *Enterococci & Escherichia (E. coli)* bacterial contamination. Below are the analytical results, based on the acceptable levels of the Pohnpei EPA Water Quality Standards:

NOT SAFE *(Exceed the standards)*		SAFE *(within the standards)*	
Sample Site(s):	*Municipality*	*Sample Site(s):*	*Municipality*
Nanpil River *(Below Hydro Plant)*	Nett	Nanpil Dam	Nett
Nanpil River, *Mwasihtop*	Nett	Awak Marine Park	UH
Kahmar River	Nett	Nett Point	Nett
Mand Swimming Pool	Madolenihmw	Nahlap Resort	Kitti
Mand Bridge	Madolenihmw	Anchorage	Sokehs
Parahu Church Bridge	Madolenihmw	APSCO Dock	Sokehs
Kepirohi Waterfall	Madolenihmw	Pwok River	Kitti
Enipein Powe Bridge	Kitti	Pohnkati River	Kitti
Pwudoi River	Kitti	Lehnmesi River	Kitti
Pehleng River	Kitti	NIHCO Marine Park	Sokehs
		Harbor Patrol Dock	Dekehtik, Nett

The public is advised NOT to swim at these polluted sites. This advisory is in effect until further sampling and laboratory analyses indicate that bacteria concentrations are within recreational water quality standards.

Water that contains excessive *E. coli bacteria* is correlated with swimming-associated gastrointestinal diseases. E. coli bacteria reside in the intestines of warm-blooded animals. Their presence in the water indicates contamination by human and/or animal waste. These polluted recreational sites pose a health risk for many waterborne diseases, some of which may cause serious illness.

NOTE: Pohnpei EPA Laboratory conducts monthly water quality testing at 21 recreational sites around the island. Advisories will be issued when bacterial concentration exceeds the levels determined safe for human exposure.

Thank you and if you have any questions or comments on the advisory, please do not hesitate to contact Pohnpei Environmental Protection Agency at 320-2927.

Approved by: _____ Date: September 17, 2009
Albert Roby
Executive Officer
Pohnpei Environmental Protection Agency

Source: Pohnpei EPA, 2009

Outer islands are particularly vulnerable as the presence of water lens makes it unwise to use septic systems for waste disposal (TNC 2003). Inadequate disposal of solid waste and lack of suitable landfill sites are also a major pollution issue in urban centers, and to a growing extent, in rural areas. The adoption of western packaged food and beverages and other products (refrigerators, cars, air conditioners, etc.) on all islands has created concentrations of solid waste that are major eye-sores, sources of pollution, and breeding grounds for rats, flies, and mosquitoes. Existing dumpsites are not adequately maintained, nor do any sites, with the exception of Pohnpei, have specific areas set aside for the disposal of hazardous material. In rural areas, garbage is

dumped along roads, in streams, and in lowland marsh areas. On some high islands, solid waste is dumped in the mangrove zone to create land for community or private use, causing human health hazards from water pollution and reducing the health of the mangrove forests and their function as fish and crab nurseries and nutrient regulators (TNC 2003). Construction of pigpens and placement of sewage outfalls near coastal areas and rivers in the FSM 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. 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 (NOAA 2008).

- **Spread of alien invasive species**

Invasive species have caused major biodiversity loss and ecosystem disturbance on islands worldwide (Englberger 2009). Invasive species, especially in terrestrial systems, are a growing threat (Space & Falanruw 1999, Meyer 2000, Cowie 2000, Atkinson & Atkinson 2000). The isolation of the Micronesian islands makes them highly susceptible to invasive plants and animals (TNC 2003). Invasive species (e.g., grasses, shrubs, vines, rats, cats, and parasitic snails) are believed to have contributed to the decline in a number species and communities currently in peril. In the last 150 years, over 457 new plants and animals have been introduced to the islands of the FSM (Falanruw 2001). The South Pacific Regional Environment Programme (SPREP) recently published Invasive Species in the Pacific: a technical review and draft regional strategy, summarizing the status of invasive species in Micronesia. In all, the report documented 10 "significant invasive land vertebrates" and 25 "dominant" and "moderate" invasive plants in FSM. The threat of invasive species remains very high with daily air and sea connections to neighboring island nations and territories with well-documented invasive species problems (e.g., the brown tree snake on Guam). In the FSM, invasive plants and pests that destroy staple crops (e.g., Whiteflies and Mealybugs) are a major continuing problem for terrestrial ecosystems and species, often overtaking areas that have been used formerly as small agricultural plots and then left unmaintained (CCNC 1997). The invasive vine, *Mikania micrantha*, otherwise commonly referred to as Mile-a-minte, is particularly fast-growing and pernicious and ongoing human efforts to control its spread and decimation of native forests and plants is ongoing (Falanruw 2002, Balick et al. 2009, Englberger 2009). Another invasive known as False sakau (*Piper auritum)* has also been found in FSM and has potential for serious economic and ecological repercussions as well (Englberger 2009). The percentage of introduced plants varies between the states with introduced species comprising 22% in Kosrae, 40% in Pohnpei, 37% in Chuuk and 39% in Yap. Some

of these introduced species have become invasive pests that have spread out of control. The spread of invasive species is a continual threat due to increased movement of people and machinery between the islands, and needs to be carefully monitored and controlled (Falanruw 2002). Introduced mammals include three species of rats, a mouse, deer, pigs, dogs, cats, and from time to time goats, rabbits and cattle, all of which can have damaging impacts on native biodiversity (Falanruw 2002). Remedial measures involve a high cost for their removal and continued maintenance of these ecosystems.

- **Infrastructure development and urbanization**

Over the last two decades, the Compact of Free Association with the United States has provided millions in funds for infrastructure improvements for dams, airports, roads, schools, hospitals and so on. This has greatly increased dredging, road construction and to a lesser extent, home-site and agricultural clearing — the major causes of earthmoving and disturbance (TNC 2003). In the current Amended Compact with the U.S., infrastructure is a priority sector, and about 30% of annual compact funding (about $100 million per year) is required to be utilized for infrastructure projects, ans this has led to increased dredging, road construction and land clearing. Between $24 - $30 million per year in new infrastructure projects are now in play, which is a massive undertaking for a country with fewer than 110,000 people, on islands that are relativey small. The projects are generally of U.S. standard and therefore rather large in scope and size. The amount of new concrete being poured is staggering, with parking lots, roads, airports and other such projects fragmenting or entirely displacing natural habitats. Although these infrastructure projects are well-meaning to improve the standard of living of the citizens of the FSM, the ecological side-effects of such projects are generally disastrous (CSP 2006). An airport expansion in Pohnpei, for example, has been a continuous assault on the shallow reefs ecosystems surrounding the area, with millions of tons of coral being dredged, and mangrove swamps and other coastal habitats being cut down, dug up and filled in. This is just one project of many. Another example is a proposed shift of the primary landfill on Pohnpei from the coast to the interior of the island, where the health and environmental ramifications (e.g., riverine and wetland water pollution, as well as spread of rodents and insects carrying disease) have not been fully considered, if at all. A review in 2008 found that coastal development is the lead cause of soil erosion and sedimentation in Kosrae; that 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; that housing developments for residential and business purposes along the coast also contribute a great deal to the problem of sedimentation; that 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; and, according to Yap Environmental Protection Agency (YEPA), large volumes of dredged coralline materials (50,000-150,000 yd3/ project) are regularly used for construction projects (NOAA 2008). This being the case, erosion and sedimentation from such land-based activities has and

will continue to degrade freshwater, coastal, and marine areas on all islands[76] for FSM. In addition, the continuing migration of people from outlying atolls and rural areas towards urban centers where public services are better, as resources decline, and the cost of living increases, has placed further pressure on the environment and natural resources (Hay, Takesy 2005). Urban areas are increasing as a percentage of land use (FSM 2005) and the resulting population pressures, escalating demand for land in the district centers and pollution are now exascerbated (TNC 2003). Directly related to this, the population for all FSM inhabited islands has grown by 22.6% since independence in the 1980's (U.S. Census Bureau 2002). The most populated centers occur at Kolonia, the national capitol on the north side of Pohnpei Island, and within Chuuk lagoon on several volcanic islands. Population growth has been rapid, with Chuuk already considered overcrowded. In contrast, the neighboring coral islands and atolls retain stable populations (Birkeland et al. 2007). Extrapolated infrastructure development pressure and urbanization are a present and serious threat to FSM biodiversity, and one of the major causes of overall biodiversity loss to the country. Degradation of rain forest, freshwater wetlands, coastal and nearshore coral reef ecosystems in all four states is ongoing because of these factors (TNC, 2003).

1.4.2 Threats to species

FSM has been under the auspices of the U.S. Endangered Species Act since it was a Trust Territory in the decades after World War II, but to date does not have an endangered species list that it has officially compiled. As discussed, many impacts on the natural environment threaten biodiversity and there have already been documented extinctions within the FSM (Steadman 1995, Falanruw 2002). There are still gaps in species distributions that may suggest a species has become extinct, such as the lack of a *Ptilinopus* fruit dove on Yap while members of this genus are present on surrounding islands. There are also extinctions known to have occurred in recent years, such as the Kosrae rail and Kosrae Mountain Starling, and extinctions that seem to be in progress, such as the fate of the Pohnpei Mountain Starling. The most prominent lists indicating threatened species for FSM are the IUCN Red List of Threatened Species, the CITES species lists and the U.S. Endangered Species Act lists of Threatened and Endangered Species. Finally there is an FSM Endangered Species Act with a list of endangered species carried over from the TTPI, but again, work remains in this arena (Falanruw 2002). From 2000-2002, the FSM did undertake another step toward this aim in the process of identifying the Areas of Biodiversity Significance throughout the federation, which includes those species most in peril. This was in accord with the Convention on Biological Diversity, ratified by FSM in 1994, which requires Contracting Parties to identify important components of biological diversity for conservation and sustainable use (**Article 7 of the CBD**). However, there are currently many gaps in the knowledge of species in FSM and the rest

[76] Soils on Micronesian islands vary from thin mantle overlying volcanic rock (often on very steep slopes) through stony clays, clay silts, loam and loamy sands, peat and swamp soils to sand and coral rubble (Spengler et. al. 1992; Laird 1982; Laird 1983a&b; Smith 1983). The high volcanic islands are especially prone to erosion and landslides. Steep mountainous areas make up 70% of Kosrae, 61% of Pohnpei, and 73% of Chuuk (TNC 2003).

of the Pacific islands. At present, there is no regional resource documenting which species exist and/or are threatened in FSM or the Pacific islands. Data is often dispersed, taxonomic expertise is absent, and nomenclature and classification systems often disputed for various species (IUCN 2008). The 2008 Red List provides the most up-to-date collated information for FSM. However, only mammals, amphibians and birds have been completely assessed according to IUCN Red List criteria at the global scale. Gaps exist at the global and regional level for reptiles, fishes, invertebrates (aside from hard corals) and all plants. Freshwater species are under-represented, as are marine species, especially when compared to the estimated number of described species (IUCN 2008).

Many species in FSM are in serious decline or are on the precipice of extinction due to the main causes of biodiveristy list above, as well as the fact that little is actually known about them. **Table 13** below highlights some of the fauna and flora that are threatened in FSM today. The table also reveals gaps in needed taxonomic data in freshwater ecosystems in particular. In terms of mammals, for FSM nearly all of the fuit bats, or flying foxes, are threatened or endangered, including, the Ulithi fruit bat, the Yap fruit bat, the Kosrae fruit bat, the Chuuk fruit bat, the Pohnpei fruit bat, and the Mortlock fruit bat (Falanruw 2002). Other mammals under threat in the FSM are the Caroline sheath-tailed bat, whales – including the blue whale and sperm whale, and the very rare Dugong (Falanruw 2002, IUCN 2008).

Birds in the FSM represent the greatest number of terrestrial vertabrates, and their declining numbers and mounting threats are sobering. Amongst the avian fauna that are facing greater pressure for existence are the Pohnpei Mountain Starling, the Pohnpei Short-eared owl, the Caroline Ground-Dove, the White Throated Ground Dove, the Micronesian pigeon, the Chuuk Monarch, the Yap Monarch, the Bristle-thighed curlew, the Large Pohnpei white-eye, the Chuuk or Faichuk white-eye, the Plain white-eye the Yap olive white-eye, the Rufous fantail and the Micronesian kingfisher (Falanruw 2002, TNC 2003). Much of the threat comes from loss of habitat due to deforestation and fragmentation, as well as hunting (TNC 2003).

Source: University of Hawaii

Reptiles in FSM, expecially the sea turtles so important to the culture, are also threatened. These include the Leatherback sea turtle, the Pacific green sea turtle, the Pacific hawksbill turtle, the Olive ridley sea turtle, crocodiles and Monitor lizards. The Monitors are found mostly on the island of Kosrae, where they are generally regarded as a nuisance and killed at will.

Climate change and other anthropogenic activities on coastal areas are combining to decrease beach and nesting site availability for the sea turtles.

As for crustaceans, only one is currently listed for the FSM and it is the Coconut crab. Coconut crabs also face an altering environment caused largely by human development and degradation of habitat. Several species of molluscs (Land snails) are also endangered or critically endangered, according to IUCN. They are the *Partula guamensis, Partula emersoni and the Partula martensiana*, found mostly in the tropical rain forests of Pohnpei and Kosrae (Falanruw 2002).

As discussed in previous components of this report, vascular plant species in FSM are extraordinarily diverse and unique, likely vaulting the FSM – a small land area – into the top three biodiversity hotspots worldwide (Balick et al. 2009). Of the identified species of plants, the following are currently listed or considered as vulnerable or threatened: *Terminalia carolinensis*, Tree ferns, Cycadeceae, Looking-glass tree (*Heritiera longipetiolata*), Ivory nut palm, Korom (*Parkia korom*), Ehphorbiaceae, Mahogany, Pitcher plants and Orchids (Falanruw 2002).

Going back to the marine environment in FSM, although there is scant information available and fewer such listings, the many sharks in FSM waters should also be considered as threatened (Falanruw 2002). There is growing evidence that sharks are likely to be in he first round of marine extinctions caused by human activity, as they are vulnerable to overexploitation due to their longevity, late maturity and slow reproductive rates (Falanruw 2002). In some areas of the FSM such as Fais, Yap, sharks are taken for subsistence purposes. While locally important, the numbers taken are fairly limited. In contrast, a great many sharks are taken by foreign fishing vessels as by-catch of other fisheries or purposely for the shark fin trade (WildAid 2002). This is quite common in the FSM, even amongst the licensed fishing vessels, many of whom unload thousands of shark carcasses on the docks of Pohnpei, Chuuk and Yap. This says nothing of the hundreds of illegal fishing operators in the vast FSM waters (Greenpeace 2009).

This leads us to a discussion on the many tuna species within FSM, which comprise the last great natural tuna stocks remaining in the world (FSM 2009). Moreoever, most of the people of the FSM rely heavily upon local fishermen to catch and sell tuna for availability in communities and the local markets. Unsustainable – and illegal – harvesting of the greatest resource the FSM has continues, with foreign fishing fleets continuing to expand (ABC 2009) – and FSM continuing to grant more fishing licenses for

desperately needed national and state revenues to help defray government operations. Already, bluefin, yellowfin and bigeye tuna are at or over maximum sustainable yields (WCPFC 2009) in the western Pacific Ocean, of which FSM is the largest and most central nation. Greenpeace International has called for high seas conservation pockets to stem the tide of depletion.

TABLE 13: Summary of Threatened Fauna and Flora of FSM from Selected Taxonomic Groups[77]

Group	Species in the 2008 Red List of Threatened fauna and flora of FSM	
	Number Assessed *(no. of endemics in parenthesis)*	Number threatened *(no. of endemics in parenthesis)*
Marine Fish	68 (0)	13 (0) [19%]
Freshwater shrimps	-	-
Birds (residents only)	136 (17)	11 (11) [8%]
Freshwater crabs	-	-
Mammals	25 (4)	6 (5) [25%]
Dragonflies	-	-
Butterflies	-	-
Evaluated invertebrates	489 (61)	108 (13) [22%]
Freshwater fishes	-	-
Reptiles	4 (0)	3 (0) [75%]
Amphibians	-	-
Evaluated vertebrates	233 (21)	33 (16) [1%]
Evaluated Flowering plants	8 (3)	6 (6) [75%]

Sources: IUCN (2008) and IUCN FSM (2000)

1.4.3 Threats to forests and grasslands

The most serious environmental problem in the forestry sector is the extent of upland deforestation occurring on Pohnpei, as well as on the high islands of Kosrae, Chuuk and Yap. The interior upland rain forests of Pohnpei, however, are in particular peril due to the aggressive sakau plantations in the upland watersheds of the island, which is likely directly proportional to both location and economic status of those cutting native forest to grow a cash crop. The conservation and biodiversity values attached to FSM's upland forests are as important as their hydrological buffering functions, in that the upland forests are habitat for over 1,000 species of plants, upward's of 80% of which are likely endemic (Balick

[77] The 2008 Red List contains assessments for 78 species endemic to the Federated State of Micronesia, the majority of which are Gastropods and Birds (IUCN 2008).

2009), as well as over 100 species of birds, with half of those residing in the upland rainforests. However, over the last 20 years the upland forest has been threatened by increasing population pressure and exploitation, as a result of (1) conversion to agroforestry and agriculture (principally for sakau), (2) human settlement, (3) road construction, (4) hunting, and (5) tourism trails. Recent attempts to mitigate these adverse impacts have centered on the promotion of community-based management regimes which combine local community and traditional institutions with municipal and state governments, through local Watershed Area Management Committees. Initial results of this approach are encouraging, and while the process is long and complex, the outcome is anticipated to be more sustainable than regulatory solutions (CCNC 1997).

Tropical Rainforests of Pohnpei

For many centuries, the kava plant, *Piper methysticum*, a series of sterile clones of a truly wild Piper species, has been used in several high islands in remote Oceania, including Pohnpei in the Federated States of Micronesia. Until modern times, its use on all of these islands was largely restricted to chiefly, priestly, and medicinal use. Because of colonial suppression and/or the use of other nonindigenous psychoactive drugs, its use was abandoned on some of these islands. On other islands, such as Pohnpei, its use has increased greatly, with substantial changes in rank, gender, motivation, time, and place. This steep rise in its use has resulted in a large increase in its cultivation. On Pohnpei, intensification of cropping in upland environments is largely responsible for more than 70% loss of the remaining native, tropical rain forest since 1975. This impact and other human activities endanger the unique upland biodiversity of this remote tropical island. Recent historical trends in forest exploitation, threats to biodiversity, and watershed disturbance on Pohnpei are some of the results. The Watershed Conservation Plan and Watershed Forest Reserve programs have been ongoing with the goal of long-term monitoring of these special and rare forests – in Pohnpei and throughout the FSM. Combined with the "Gorw Low" campaign being run by the Conservation Society of Pohnpei, there have been some successes in stemming the rate of forest loss.

Merlin and Raynor, 2005, cited in Pacific Science Journal.

Yet deforestation of native forest cover remains the most serious threat to terrestrial biodiversity in FSM, so that the island of Pohnpei for example has lost 70% of its native forest cover in the last 35 years. Comparison of the area under closed-canopy natural forests for Pohnpei in 1975, 1995 and 2002 show a marked decline of dense forest from 43%, to 14% to 12% of the land area respectively (See **Figure 4** above). While forest loss can also be attributed to human settlement in the higher forest zones, which is the case for all of the high islands of the FSM, it is largely due to the commercial value of sakau on Pohnpei, and increasingly in Kosrae and Chuuk as well, which is a popular midly narcotic drink, much like Kava in the South Pacific. Much of the forest loss for the high islands has also been due to road construction projects that fragment native forest cover. With roads and machines come also fast-growing invasive plants (Falanruw 2002), such as the Chain of love (Antigonon leptopus) and the Mile-a-minute (Mikania micrantha), the latter of which can rapidly destory whole sections of forest by choking

Source: Soil Survey of Islands of Pohnpei, FSM, USDA 1982.

out sunlight and hogging nutrients and water from the soil (Englberger 2009). Due to several ongoing conservation campaigns, such as the "Grow Low" outreach campaign in Pohnpei, the rate of native forest loss appears to have slowed, but upland rainforest cover across the FSM continues to some degree. Current aerial photographs of all the islands are desperately needed to ascertain updated vegetation information (NBSAP 2002). Consistent long-term monitoring is also a major activity that needs to be upgraded for the other high islands of the FSM, as the status and trends for upland forests in general are scant. For Pohnpei, as an example, where consistent upland forest monitoring is taking place, from 2006 and 2009, over 1,140,000 m^2 of forest encroachments on native upland forests and at least 200 detections of illicit clearing were detected (**Table 14**) .

TABLE 14: Trends in detection of forest encroachments (for Pohnpei only)

Year	Area encroached (sq. m^2)	Detections
2006	43,845	71
2007	107,500	44
2008	874,275	61
2009	114,394	24

Source: Conservation Society of Pohnpei (2009)

Deforestation for plantation agriculture and commercial farming, particularly on steep slopes, has led to accellerated soil erosion which affects inland and coastal wetlands and associated ecosystems and species due to siltation. Continuing encroachments into the delicate watersheds are of huge import and consequence to islands with such a relatively small land scale.

Grass and fernlands, or what are more commonly identified in the FSM as fern-sedge savanna ecosystems, are also facing threats – mostly from human encroachment and utilization for agriculture, as well as burning (Falanruw 2002). They are dominated by *Ischaemum* grass or *Gleichenia* ferns and in Yap in particular, where the type is more extensive and related to a long history of a monsoon rainfall and drought pattern, there is a set of native savanna species including some endemics, which are also threatened from large infrastructure projects, burning and roads. In Pohnpei, this ecosystem is thought to be one of the primary habitats and hunting grounds for the short-eared owl, and extremely rare endemic species rarely seen (TNC 2003). The Pohnpei short-eared owl is a top predator of introduced rodents and mice on the island.

1.4.4 Threats to freshwater wetlands

The status of most aquatic ecosystems in FSM has deteriorated over the last three decades, as a result of infilling and infrastructure construction, clearing of vegetation, deforestation, hydrological alterations, improper land use practices that result in siltation, and pollution from small-scale piggery run-off, untreated sewage and other industrial and urban effluents. Reclamation of wetlands in urban areas habitats due to landfills for housing and commercial and industrial development has been steady, especially in the more populated centers of the high islands. This has led to a drastic reduction of species associated with these ecosystems (TNC 2003). For instance, one intact native freshwater swamp forest remains in the FSM (*Terminalia carolinensis*) and continued wetland cultivation with swamp taro has also caused loss of native wetland habitats.

pacificnotes

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Simpson Abraham, Director of the Development Review Commission; Richard Creed, Civil Engineer; Bruce Howell, Director of Public Works; Moses Pelik, DRC Environmental Impact Assessment Specialist and Marcel Jonas of Survey and Mapping discuss the various scenarios associated with putting a road through the Yela Ka Stand, the last forest of its kind in Micronesia.

Kosrae

Last Ka Forest Under Threat

A major portion of Kosrae's 250 inches of annual rainfall drains through the Yela basin, an area of land that comprises a large portion of the island's total land mass, and contains what many scientists consider to be the world's last remaining intact stand of *Terminalia Carolinensis* trees. The tree is more commonly referred to as Ka on Kosrae, and it is the predominant species found in the freshwater swamps, acting as filters and purifiers between the upland mountains and the mangroves, sea-grass beds and reefs. The ongoing circumfreutial road project is now less than a mile away from the Yela drainage and environmental groups, American and Japanese scientists from the U.S. Forest Service, and other concerned citizens are looking for ways to keep the forest, and its pristine watershed, away from the effects of heavy road-building machines and encroachment.

The Terminalia forests were once common on both Pohnpei and Kosrae, but heavy logging during the Japanese era, and farming, development and settlement in the ensuing years has left the Yela Ka stand as the last of its kind globally. The government has been sending personnel from various agencies into the massive swamp to ascertain the most viable route, both in financial and environmental terms. Simpson Abraham, the director of the Development Review Program, the environmental and permitting arm of the government, has been spearheading efforts to bring awareness to what he considers to be "an area of particular concern" on Kosrae.

Along with Bruce Howell, the director of Public Works, Abraham recently brought in Richard Creed, a retired civil engineer who resides most of the time in the woods of Northern Idaho, but over the last decade has become well known in environmental circles for his solid work on roads in Yap, Guam, Hawaii and Palau. According to Abraham, the forest is of major biological, ecological, aesthetic and economic importance to the island and the people. His major priority at this point, he says, is to get together with the main landowners and try to come to a consensus on the value of saving rather than cutting the area. If you are visiting Kosrae, make the effort to get a boat ride into the area for a hike. The towering trees, with their huge wall roots and canopy of nearly perpendicular branches, are about as tropical as one can get.

—Olivier Wortel

Marshall Islands

Report Uncovers RMI Payroll Fraud

The *Interim Report No. 1 (II)* by the Marshall Islands Task Force on Accountability has finally been made public. It was completed almost two years ago. Copies of the report, subtitled *Tax Evasion By Certain Employees of the Republic of the Marshall Islands*, are finally being circulated among Nitijela (RMI Congress) representatives. A copy of the report was furnished to *Pacific Magazine*.

It details a scheme by whichMiam Motellang, the chief of the government's payroll division, and several of the division's employees altered payroll records to give themselves and friends reductions on withheld taxes, bogus increases in salary—many times retroactive—and false overtime payments.

The report details how the payroll division chief was paid an unauthorized amount, with the false raise being applied three months retroactively. A Payroll Division accountant was authorized to be paid at the rate of $9,380 per year, but for two years was paid at the unauthorized rate of $13,238 per year.

The scheme seems to have grown, and more than 40 government employees are mentioned by name in the report, which documents forgery of overtime documents and forgery of the Personnel Action Forms required to give government employees promotions. The report recommends that Miam Motellang, Freedly Dribo and Ila Atlaia "should face immediate criminal prosecution and termination from government employment." Motellang and Dribo are scheduled for jury trials in November. Atlaia has retained counsel.

The Task Force found that "a former Minister of Justice," who goes unnamed, "used funds provided by Taiwan to provide additional compensation to certain select members of the Department of Public Safety."

In the good news department, the Task Force did admit looking into the payroll records of the current and former presidents, Cabinet and Nitijela. They found no illegal alterations to their payrolls in either income or deductions.

—Scott Whitney

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Source: Pacific Magazine, 2003

Pollution from piggeries and human waste in each of the forest zones – from the upland rainforests to the mangroves and estuaries – are also having an especially negative impact on freshwater wetland and coastal ecosystems and species. Increasingly, rivers are becoming unsafe for people to swim in due to such pollution (see **Figure 11** above). The streams and rivers in particular, sources of water that most, if not all, of the people on the high islands utilize for their daily drinking and bathing needs, are particularly succeptible to changes in forest cover and siltation. Moreover, important riverine species of crustaceans (river prawns) – as just one example – are quickly affected by loss of upland forest cover, and the resulting change in stream flow, turbidity and temperature. These are a primary food source for many of the interior island dwellers. Rivers are not only the primary water source on the high islands where the majority of the FSM people now reside,

they provide food when clean, and they are also important cultural and recreational areas. Restoration of these degraded ecosystems is sorely needed.

1.4.5 Threats to coastal and marine systems

Market survey results in Pohnpei indicate that at a minimum, 2,500 lbs of reef fish are being sold at the markets daily (1,000,000 lbs a year). These amounts do not include subsistence use, what is sold to schools and hospitals, funerals or amounts of exported fish. If these sources are taken into account, it is likely that the amount of reef fish taken from Pohnpei's reefs exceed 4,000 lbs daily (1,500,000 lbs annually). Preliminary, unoffical results from similar surveys recently conducted in Yap and Kosrae have yeilded similar numbers. An example of the immature fishery problem can be highlighted with the highly threatened Napoleon Wrasse. The REA observed 63 Napoleon Wrasse in Pohnpei of which, the majority observed were immature, indicating that the mature fish were highly exploited. The REA found stronger habitat protection (MPAs) are needed in areas of high biodiversity. Therefore the establishment of additional MPAs in species-rich passages between outer reef and lagoon habitats such as Ant and Pakin atolls are suggested, two of the premiere atoll biomes in the nation, with super healthy reefs and other nearshore ecosystems. Designating such atolls in the FSM as National MPAs will serve both functions of fishery and habitat protection. In addition to MPAs, the FSM needs to create fishery management policies. There is no current policy on size limits, sales limits, incorrect market price or other significant factors contributing to the over-fishing problem. Market survey results indicate that at least 70 percent of all the fish sold at markets across the FSM are immature fish. Furthermore, many of these fish are caught with eggs, which would otherwise replenish the reefs with more fish.

Source: CSP, 2006

Comprehensive coastal habitat surveys have not been conducted in the FSM within the last two decades, and as such, it is difficult to get an overall picture of the health and/or amount of degradation that may be occurring in the coral reefs, estuaries and lagoons, mangroves, seagrass beds, salt marshes barrier beaches and small atolls. What is clear is that overuse and overharvest are serious problems that are mounting on the reefs. As coastal populations rise and the centers become more crowded, pressures on the coastal and marine ecosystems increase, a pattern that is now occurring in the FSM. Besides the negative environmental impacts, there are serious socio-economic implications as well. Over-fishing affects the reef eco-system in particular in three ways. First, there is little to no return or replenishment to the reef. Second, over-fishing undersized fish leads to a reduction in overall population. Finally, small fish have little value economically causing an increase in fishing pressure. With a corresponding failure to legislate fishery management practices this will promote; (1) a continued decline in reef fish populations; (2) increase in poverty among fishing communities; (3) a reduction in revenue to fish markets and state agencies, and; (4) a compromised ability of the state to develop a robust marine-based tourist industry (e.g. dive and snorkel tourism) (CSP 2006). Fish market surveys conducted in 2007 and 2009 in Yap and Pohnpei reveal levels of harvest that are precariously

unsustainable (Allen et al. 2007). Moving out to the high seas, the FSM faces a similar issue. Tuna, the most valuable natural resource to the FSM, are threatened with extinction due to commercial fishing practices and a lack of protected marine reserves (Greenpeace 2009). Less than 1% of the Pacific is protected, and yet up to 90% of its large predatory fish may have been lost already (BBC 2009). The use of trammel nets, purse seines, explosives (blast fishing), bottom-set nets, and trawlers that use long drift nets, have all served to destroy marine habitats and biodiversity, while nylon gill nets spell death to turtles and small marine mammals leading to serious problems of bycatch (CCNC 1997; Greenpeace 2009). Again, the socio-economic implications of the loss of the tuna biodiversity would be monstrous.

Other local and global actions are having serious effects on the coastal and marine ecosystems of the nation as well. Coral dredging and sand mining are ongoing issues that are having serious adverse impacts, creating tremendous human-induced disruption of coastal processes, and a corresponding decline of coastal biodiversity (CSP 2006, YapCAP 2007). Coastal development and runoff over the past 20 years due to the availability of large amounts of funding for infrastructure projects under the Compact with the U.S. has led to the need for raw materials, and this has led to major increases in dredging reef flats for road construction and a subsequent filling in and over mangroves, estuaries, reef flat and seagrass meadows to build airports, roads and the corresponding industrial installations – e.g., asphalt plants, coral crushing and grinding operations - which further results in increased sediment and nutrient deposition on reefs and other coastal ecosystems (Allen 2005). These often are without sufficient sediment-stabilisation mitigation devices to prevent further siltation and degredation of surrounding reefs (McKenzie and Rasheed 2006). From 2004 to 2023, 30% of all annual compact funding will go toward infrastructure projects – for FY2010, nearly $25 million was allocated for this sector, while the environment sector received $1.5 million (JEMCO 2009). Data on actual tonnage taken is not readily available, but in Pohnpei there are more than 50 dredge sites surrounding the coast, with each dredge site requiring at least one access road through the mangroves, further fragmenting prime nurseries and filters to the reef (NOAA 2008). Sedimentation from these activities has contributed to the degradation of nearshore coral reef ecosystems in all four states (TNC, 2003). According to the Yap Environmental Protection Agency, large volumes of dredged coralline materials (50,000-150,000 yd3/ project) are regularly used for construction projects (NOAA 2008).

According to the scientists report from the recent REA conducted in Pohnpei, “Dredging and coral reef mining have caused significant impacts to marine biota around Pohnpei. In the present study, dredge/coral reef mining impacts, combined with sediment run-off, were clear in Station 13, with low

species diversity, particularly on the deep slope, and very high levels of silt reducing water clarity to only a few metres visibility" (Turak and DeVantier 2005). Compact-related coastal developments and land use patterns have also resulted in some coastal erosion and degradation of the mangrove ecosystems in Kosrae, placing the health of reefs at risk (Maragos, 1993).

Mangrove forests are important to the maintenance of the natural lagoon ecosystem, but overharvesting is occurring. In addition to disecting the forests for dredging activities, there has been extensive use of mangrove wood for cooking, housepoles, sawn timber, woodcarvings, and other purposes resulting in over-exploitation occurring in some localities on Kosrae, Pohnpei and Yap. Progress on these critical resource management issues will require legislation changes, public awareness education, and the investigation of alternative methods of resource development which are more sympathetic to environmental constraints (CCNC 1997). The naturally fragmented mangrove swamps of the FSM are also being increasingly threatened due to fill and development activities. Similarly, seagrass beds in lagoons and coral reefs have also been damaged or degraded due to the use of destructive fishing practices and irresponsible and careless road and home construction along the coasts; a road built in Kosrae in 2002 down into the previously unroaded village of Walung created havoc all along the southern coast of the island, creating vast soil runoff and siltation to some of the major seagrass meadows of the island.

Coastal waters in FSM are also being polluted by the release of raw sewage, untreated or partially treated wastewater and other toxic substances from the urban environment. The dumping of solid waste in coastal areas and in mangroves is particularly daunting, often with domestic wastewater coming from land-based activities directly or conveyed through rivers, estuaries and lagoons. Lagoons and estuaries are also severely threatened by pollution from inflow of sewage, untreated industrial effluents, urban wastes and waste oil; and soil disturbance from agriculture, deforestation, mining and construction inland. Construction of pigpens and placement of sewage outfalls near coastal areas and rivers in Kosrae, for example, directly affect the health of corals in the near fringing reefs around the island. Landfills within mangrove areas and the conversion of mangroves into dump sites are major contributors to coastal pollution. In Pohnpei, coastal pollution is localized mostly at river mouths and estuaries and 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 (NOAA 2008). All of this combines to weaken the biological safety net for the majority of the people of the FSM who rely on these ecosystems for their sustenance and health.

Finally, climate change induced sea-level rise is likely to have significant impacts to marine biodiversity (Buddemeier 1993; Wilkinson 1999) — effecting not only threatened species and ecosystems such as turtle nesting beaches, low-lying seabird nesting areas, and mangrove forests (TNC 2003), but people as well. The economic effects of climate change on the coastal zones where the majority of people live

will be high, as whole communities will have to be moved and infrastructure costs increased to be able to withstand it. In 2004, Typhon Sudal in Yap destroyed an entire island's infrastructure and wiped out forests and reefs (Wortel 2004). The cost to rebuild was in the millions of dollars, an effort largely undertaken by FEMA. Continued sea level rise, warmer ocean waters, super typhoons and coral bleaching can be expected if current global trends continue.

Group: List 83 corals as endangered

HONOLULU — Environmental activists are petitioning the federal government to put 83 coral species on the endangered species list. They say global warming and ocean acidification are threatening the corals with extinction. The Center for Biological Diversity said Tuesday that the coral species in question are found in Hawaii, Florida and U.S. territories in the Caribbean and the Pacific.

Source: Pacific Daily News, 2009

Recent bleaching events in the FSM have been recorded after the series of rapid ecological assessments conducted throughout the FSM. There was one major coral bleaching event 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, 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, however 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 (NOAA 2008). Though the reefs of FSM are by and large in good condition – some of the best in the world (TNC 2003; NOAA 2002) – these recent bleaching events are a potential troubling sign of future impacts from the effects of global warming.

The FSM Climate Change National Communication (1997) states that, "Human threats to the health of the nation's fragile coral reef ecosystems are increasing at an alarming rate. A rapidly growing population, increasing urban and rural coastal congestion, and stresses associated with modernization hold out the very real short-term danger of irreversible reef damage occurring in the near future. The direct sources of these pressures on the FSM's coral reef ecosystems have been well documented: mechanical coral and sand dredging; blasting channels; siltation; pollution from garbage disposal, human sewage, animal waste from commercial operations; freshwater discharge; destructive fishing methods including the use of dynamite, bleach, cyanide and other poisons; overexploitation of reef fishery stocks resulting from the use of imported nets and overcollection of various other marine species such as sea cucumber, crab, shellfish and live coral; damage to live coral from anchor dragging; construction of infrastructure on reefs such as ports, airports and roads; and, a lack of marine protected areas."

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, and the second for the FSM (the Utwe-Walung Biosphere Reserve in Kosrae was designated in 200 largely through the efforts of the Kosrae Conservation and Safety Organization). And is 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. 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, restrictedive 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.

NOAA 2008; Micronesian Alliance 2004

1.4.6 Threats to agricultural biodiveristy (and its impacts)

The FSM is still a place traditions are still intact, and respect – including respect for the environment – is still a pillar of society. However, this is changing rapidly, as traditional values are replaced by contemporary lifestyle and beliefs (Balick et al. 2009). FSM traditional knowledge has been carefully developed since the arrival of the first people to the islands, who deliberately constructed the body of traditional botanical knowledge and practices that comprise its collective ethnobotany.

In a world rocked by global change, traditional knowledge and practice has an important role in maintaining a healthy environment and people (Balick et al. 2009), grounded in a foundation of their surroundings, while moving and adapting into new methods of living. Local foods – and the knowledge of how to grow and use them – combined with a more active lifestyle, can help address the epidemic of diabetes and other modern lifestyle diseases that are plaguing the Micronesian people. Like the loss of ecosystem services over time, so to do we see in the modern context the loss of traditional varieties of crops associated with the inevitable loss of valuable traditional knowledge about their cultivation requirements and associated cultural practices over time. Quite simply, agricultural diversity is lost due to the advancing global pressures on the FSM, in the form of climate change as well as development. An example of this can be seen in Pohnpei, where two decades ago 178 yam cultivars were recorded, where only a few dozen can be found today (Balick et al. 2009).

The loss of agrobiodiversity, like fisheries has important consequences not only in terms of food security, but also health implications and cultural identity. Kosrae, for example, is well known throughout the region for its excellent citrus production; people stop on the island to purchase the fruits and it is also exported to neighboring islands. Moreover, many people in the FSM earn their income from farming, either directly or indirectly as sold to local markets or consumed by the family. Agroforests thorughout the landscape and around homes are ubiquitous; nearly everyone has some bananas, or coconuts, or pineapple, papaya, melons, cucumbers, yams, taros, breadfruit and so on. Perhaps more than anything else, it is what makes the FSM the FSM. Without the security of the agicultural safety net as part of a total menu – both on the land and in the water – the majority of people in the FSM would find life much more difficult.

1.5 Implications of biodiversity loss

Many people in the FSM face hardship and poverty (Nimea, 2008). And the incidence of the Basic Needs Poverty Line – the measure of relative poverty and hardship in the FSM – is growing: between 1999 and 2005 the BNPL increased from 27.9% to 32.2%, with some states seeing a significant worsening of the poverty situation (Abbott, 2008). Additionally, commensurate with a buy-in to a widening capitalistic lifestyle, the gap between the wealthy and the poor is also growing. The most recent UNDP analysis purports that the weekly household expenditure was almost ten times higher in the richest 10% than in the poorest 10% of families. Higher rates of poverty – one in three people fall below the BNPL in FSM (Abbott 2008) – lead to greater dependance on ecosystems (TNC, 2002, CCD, 2006) by the underclass in particular. Combined with low wage rates and few job opportunities (35% unemployment), and these pressures in turn lead to further extraction of local resources and biodiversity loss, which in turn may likely result again in a deepening and broadening of the poverty index for the nation.

Source: FSM 2005 HIES Analysis, 2008

Ultimately, biodiversity loss must be seen as an economic loss, an opportunity lost. The value of the continuously free ecosystem services that nature provides is nearly priceless. Yet we can measure the economic value in a myriad of ways. Perhaps it is hard to judge the value of a clean air molecule, or decide how much a pool of clear, glistening water should cost, fresh shrimp in a stream, or even the sight of a blue sky and the distant break of the reef below without smog clouding the image. What is the value of a turtle nesting on a beach, even if you don't know it, cannot see it? The answer is that on the face of it you cannot put a price on it; not to say that it does not have value, because it obviously does, but value is subjective. But what we can affix numbers to is the amount of fish sold in a fish market, the price of a gallon of pure water, the percent of GDP that fishing licences contribute to the economy, the number of tourists that paid to dive in a reef passage or swim in a pool below a waterfall. These are what are known as ecosystem services. And the degradation of ecosystem function as it moves further from the climax state has an inverse relationship with their value over time. As FSM progresses into the second decade of the 21st century, there are unmistakable signs of environmental stress and degradation of the federation's biological wealth. The country supports a population of about 110,000, with 32.3% of the population living below the basic needs poverty line: (UNDP Pacific Centre, FSM HIES Review, 2005 data), and has, like all of the islands of the North Pacific, had to grapple with the challenge of balancing mounting economic development with safeguarding the natural environment on which that economic development depends (Nimea 2006). This says nothing of the global pressures of climate change. Although the FSM maintains exceptionally strong cultural ties to family, community and the land (Balick et al. 2009), despite several centuries of occupation, it is also incrementally changing from an agricultural/subsistence to a technology/commercial based society, and presently follows a sustained economic growth policy (SDP 2003). While it is obstensively focused on development of a private sector-led and agricultural and fisheries export-oriented economy in terms of macro-economic development over the long term – along with large annual inputs toward infrastructure

projects – insufficient attention has been paid to ensure environmentally sustainable development. This has resulted in anthropogenic impacts of over-exploitation of bio-resources, habitat destruction, land degradation, pollution, poor disposal of wastes and continuing expansion of vehicular traffic that depend on fossil fuel combustion. There is also a significantly high level of unemployment and relative hardship in the country despite many federal and international programs working to alleviate these issues. Educational[78] and health systems are improving through the Compact of Free Association with the United States, which prioritizes those two sectors in order to assist the FSM build a strong foundation for socio-economic advancement. But nearly 80% of the people remain without appropriate health insurance (MiCare 2008) and receive substandard care. The implications of biodiversity loss, however, for a developing country such as the FSM can be considerable and wide ranging, not only health-wise, but also economically. As only 25% of the population is as yet urban (CCNC 1997), a considerable proportion of the population continues to depend in varying degrees on biological resources for their food, income and well being. The island's varied bio-resources are also the basis for a range of economic activities. Foremost among these are agriculture, which comprises 25% of national GDP in the economy (CCNC 1997), research and conservation activities, the marine and brackish water fishery and tourism. And yet the long term value in these activites is not certain. Many communities, in an effort to raise cash for municipal coffers, bulldoze a road through the mangrove forest and start dedging coral reef, which is sold by the truck load for any number of ongoing construction projects around the island. The cost for one yard of dredged coral is about $15 to the end buyer (about $45 for a large truck load). The low cost of this material thus acts as a disencentive to environmentally appropriate behavior in two ways: first it makes it the preferred fill material to other more expensive material, say dirt or crushed rock, and second, the dredging company, in an effort to make more money, dredges as much as possible. This is just one example of a direct jaxtaposition between economic gain and environmental loss. In the end the impacts of biodiversity loss will be the loss of ecosystem services, which represents a loss of ongoing economic inputs over time. These are services which clearly provide for a more balanced Micronesian society. Some other negative impacts on human well being from adverse changes in biodiversity are presented below as examples from forest, inland wetland, coastal and marine systems.

1.5.1 Impact of changes in forests

The loss or degradation of native tropical rain forests results in reduced and irregular water flows and reduction of base flow of streams; this will affect many communities and villages in the FSM, particularly in the forests of the high islands. The people also depend on these forests considerably for fuelwood, poles, posts, sticks, food and medicinal plants and from adjacent secondary forests for subsistence as well as cash income (Balick et al. 2009). A reduction of these resources certainly affects the rural economy of these areas. Other serious consequences of deforestation and forest degradation

[78] The literacy rate was 85% (ADB 1997, FSM 1996); however it has likely improved in the last ten years.

on human wellbeing are soil erosion and consequent loss of soil fertility. This in turn leads to reduced agricultural productivity.

1.5.2 Impact of changes in freshwater wetlands

FSM's inland waters are the primary source of water for drinking and bathing. Pollution of these waters with faecal matter and urban petrochemicals and effluent from piggeries[79] can be expected to increase incidence of disease among rural people, due to contact with polluted water and consumption of contaminated fishery products. At least one reservoir in Pohnpei (Nanpil) is the source for hydro-power that has the potential to supply up to 30% of the island's electricity requirements. Deforestation and improper cultivation practices in upper catchment areas of drainage basins of rivers however persists. Not only does this adcersely affect wildlfe that inhabitat these rivers and streams, the regular supply of unsilted water for human consumption and use and hydropower generation for the people of the nation – a major economic consideration - who live on the capital island will only be possible if the forests in the catchment areas of streams and rivers are properly cared for and protected. Waste disposal at open dumps in low-lying marshy lands is detrimental to wetland biodiversity as well as the health and well being of people living in their vicinity. Both marine and freshwater fish, including endemics, are at risk. This will be detrimental for the sustainability of the local near shore fishery as well, which is substantial.

1.5.3 Impact of changes coastal and marine systems

Many coastal habitats help stabilise the shoreline. Coral reefs especially act as natural barriers against coastal erosion by dissipating high-energy wave action, which is particularly heavy during typhoon incidents. As a consequence when such weather patterns hit with more frequency, as they are expected to do, the costs to governments and to communities in further erosion of shorelines and damage to infrastructure will escalate. Sea coral mining which involves the destruction of reefs that form natural barriers against wave action has caused severe coastal erosion along many coasts of FSM. This adversely affects coastal communities due to damage to houses and other infrastructure and the retarding of coastal activities such as fishing, tourism and recreation. Indeed, the fishery sector – both nearshore and offshore - earns valuable foreign exchange through the export of marine and aquaculture products, and provides direct employment to many people, while indirectly sustaining a majority of the populace. However the traditional coastal fishery is being severely affected due to over fishing. Likewise degradation of estuaries and lagoons, coral reefs, mangroves, seagrass beds and salt marshes that function as vital breeding and/or nursery grounds for numerous species of fish, crustaceans and molluscs, will undoubtedly reduce the commercial value in the inshore and offshore fishery and affect the fisher communities that depend on them for their livelihood.

[79] There are nearly 50,000 pigs in the FSM, almost one pig per every two people (CCNC 1997).

It takes 15 years for a blue fin tuna to reach maturity (CNN 2009). Tuna are the single most valuable resource the FSM has and provide as much as 15% of national GDP (CCNC 1997). The people of the FSM are fishers, and the catch of tuna is an important and necessary component to their way of life; it is an expected source of protein as well as income opportunity throughout the islands. As stocks continue to vanish, so to do the essential food and income oppportunities of atoll and high-island communities.

1.6 Overall prognosis for the future

Most scientific assessments and reports indicate a continuing negative trend for biodiveristy and cultural loss within the FSM. With a little research and some careful observation, it is not difficult to come to this conclusion: the pressures and threats on this region of the world are enormous. They also often note the fragility, uniqueness and importance of both. Current indicators (see **Chapter 2** on NBSAP Status) suggest that the present government and non-government environmental agencies do not have adequate technical capacity, that there are not enough financial resources dedicated to the environment, that long term monitoring programs and updated biodiversity feedback is lacking, and that laws and policies are both outdated and insufficiently enforced to adequately address these environmental challenges (SDP 2003). Those issues have been present historically, and they remain today. The FSM is a unique place in the world, with huge challenges. If it is to ensure some greater measure of biodiversity health throughout this century, it will require a regional, if not international effort. The FSM is a member to most of the major international treaties directly or indirectly related to international biodiversity concerns, inlcuding the one that this report attempts to ammeliorate. This in itself is significant. But even moreso, there are many hard working people in the FSM, in government and in the private sector, who continuously strive to realize the commitments and goals of these treaties. The NBSAP is an ongoing case in point, and its imnplementation will be discussed in detail in the next chapter. Additionally, the national Strategic Development Plan, the policy document guiding the underpinning principles of the nation, has a clear and difinitive voice when it comes to the environment as one of the three pillars of development[80]. The SDP recognizes the causes of environmental degradation – population growth and migration, over-harvest of bio-resources due to increased economic expectations and needs, destructive human activities for personal, short-term economic gain, climate change and natural hazards, and alien invasive species; and then the major development policy guiding document proceeds, over the course of 118 pages to meticulously examine and address these issues. The environment matrix contained within the SDP is perhaps the most thorough and excellently prepared sector of all the sectors within the nation's major strategic development document. In and of itself it is an outstanding environmental policy document, combining

[80] This idea was mainstreamed into the environment sector working group discussions in 2003 by the state of Yap, who coined the third pillar, or *nguchol* (stone) as the environment pillar, between the economic and social pillars of development. The three nguchol collectively maintain the proper balance in society (YBSAP 2004).

pinciples and core ideas from the *National Biodiversity Strategy and Action Plan* and *A Blueprint for Conserving the Biodiversity of the Federated States of Micronesia*[81]. Both documents are part and parcel of a historical process that has developed into a highly organized and determined conservation coallition within the FSM, if not the entire Micronesian sub-region. The growth of this coallition, led chiefly by the establishment in each of the FSM states of central, state-wide conservation NGOs, has been strong; non-profit organizations as an economic sector contribute more than 19% to the Gross Domestic Product to the nation, up from 9.5% in 2001 (Nimea 2006)[82]. In this vein the FSM has done some serious work and continues to do so, in many ways leading the world by example. Its' blueprint for conservation – a singular document for a singular nation – has and should continue to go a long way toward conserving species, natural communities and ecosystems in the years and decades to come. This document provides a clear biodiversity-assisting roadmap for all those who are interested toward action.

There is also a clear awareness – and it needs improvement at the policy and business levels of society - that economic development and the well being of people is dependant on a healthy environment and abundant bio-resources (Smith 2001). This is excellently underscored in the recent National Assessment Report in Support to the Formulation of National Sustainable Development Strategy (Nimea 2006). Biodiversity, the report iterates in the first paragraph of the section on environment, is the "foundation for the country's long-term economic self-sufficiency," and goes on to suggest that "long term prospects for economic self-sufficiency rely on three sectors highly dependent on the continued vitality of the natural environment: fishing, agriculture, and tourism."

Some of the essential areas of improvement remain to broaden the number and scope of integrated conservation areas on land and sea and to be able to effectively protect their climax function; to begin to restore degraded ecosystems: forests in particular; to strengthen policy and enforcement; to get a better buy-in from the developers and companies who profit the most from extracting the wealth from the environment and, crucially, to create government-backed disincentives to destruction and degradation and promote the growth of a more green economy through sweeping incentive programs; and finally, to commit local and international resources to the cause.

Despite the many institutional, financial and systemic problems that beset the effective conservation of biodiveristy, the FSM – along with a cardre of high level international support - is ready and willing to meet the massive challenges ahead. The prognosis is not dire, not yet; instead it remains…steady, just like the collective natural culture and tradition of the FSM; always steady ahead.

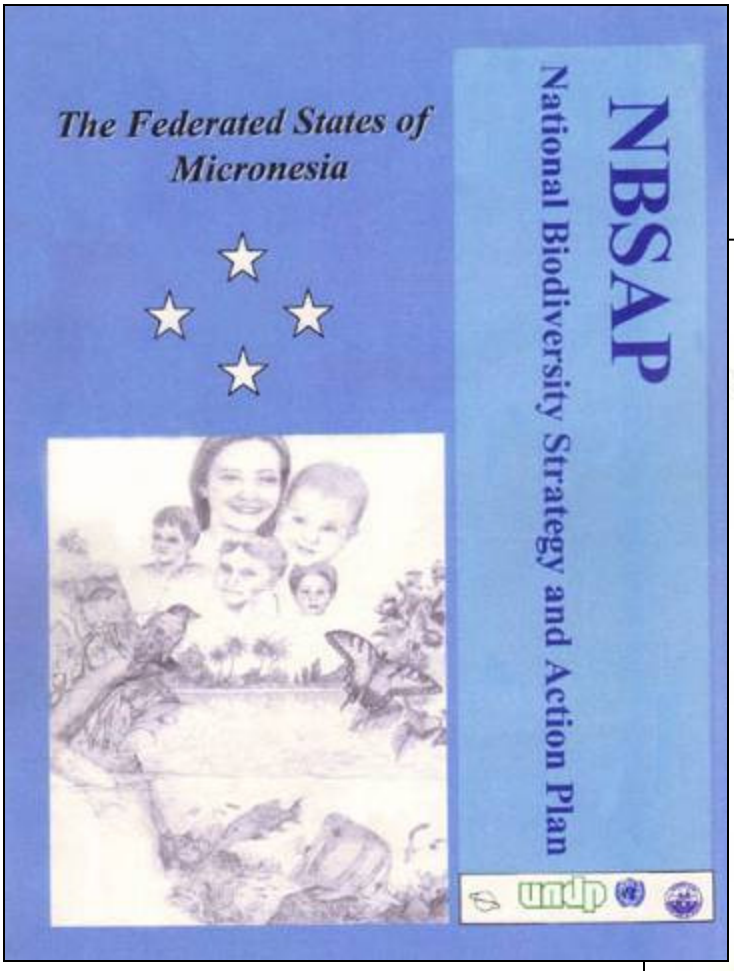
[81] This will be discussed in more detail in Chapter 2.

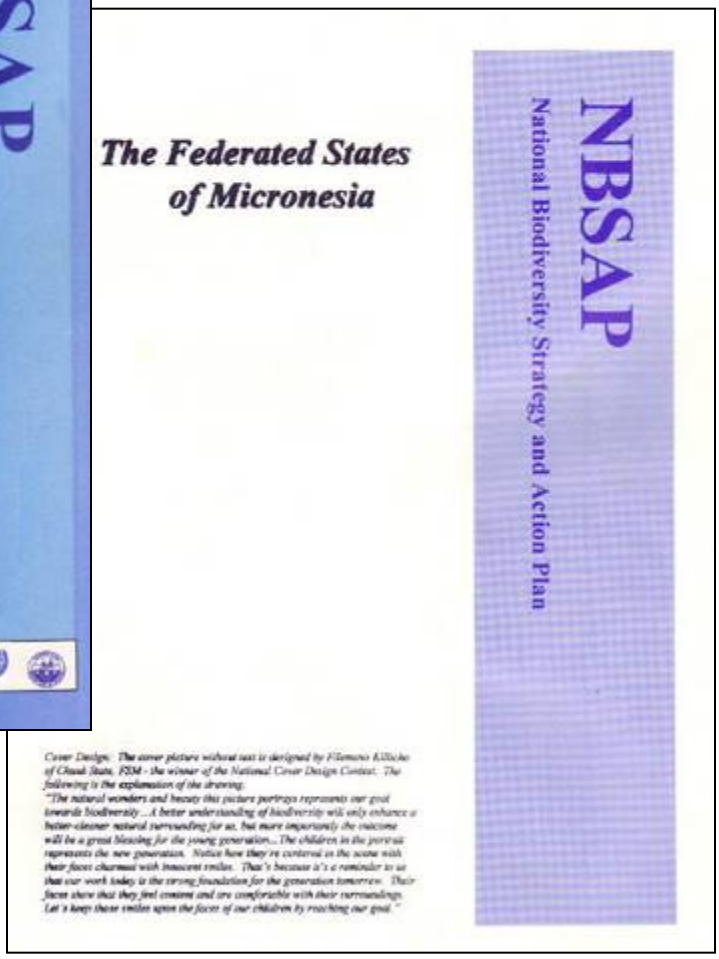
[82] A current estimation based on the rate of growth from 2001 to 2005 (9.51% to 13.58% over the five-year span).

Fourth Country Report from the Federated States of Micronesia to the United Nations Convention on Biological Diversity

Chapter II

Status of National Biodiversity Strategy Action Plan





"The natural wonders and beauty this picture portrays represents our goal towards biodiversity…A better understanding of biodiversity will only enhance a better-cleaner natural surrounding for us, but more importantly the outcome will be a great blessing for the young generation…The children in the portrait represents the new generation. Notice how they're centered in the scene with their faces charmed with innocent smiles. That's because it's a reminder to us that our work today is the strong foundation for the generation tomorrow. Their faces show that they feel content and are comfortable with their surroundings. Let's keep those smiles upon the faces of our children be reaching our goal."

---A quote from Filemeno Killicho of Chuuk State, FSM, on the inside cover of the National Biodiversity Strategy Action Plan, explaining the artwork he created that serves as the cover for the Federation's NBSAP. 2002.

"Our coral reef systems need all the protection we can give. In the past, marine resources were culturally appropriated to specific groups. This avoided the tragedy of the commons where resources available to all are used up or destroyed. Having a traditional precedent for managing access and with increased threats from today's powerful technologies, economic incentives for unsustainable exploitation and rapidly rising population people need to become reengaged with sustainable stewardship of their marine areas."

---A quote from Margie Falanruw of Yap State, FSM, from the Yap Almanac Calendar 2010, Yap's Natural Heritage: From Ridge to Reef, a publication put out annually by the Yap Institute of Natural Science since 1980.

Chapter 2

2.1 Introduction

The FSM NBSAP is a foundational document underpinning the development policies of the Federation, and is in fact one of two such documents that guide the sustainable development of the country across the social, economic and environmental pillars of government and society as a whole[83]. This chapter will discuss the status of the FSM NBSAP – as well as some aspects of the State Biodiversity Strategy and Action Plans (BSAPs) – and its implementation in practical terms generally, covering how the NBSAP strategies and themes have been implemented and thereby affect development policy and practice. Furthering this idea, this chapter will also discuss how the ecological mindset is applied to all development processes, or what is otherwise popularly termed, *mainstreaming*. This is a very important ideal in terms of how the NBSAP is applied in the progression of every day island life for the resident populace, as it should, by variously accepted international measures, work toward improving the quality of life of the people, rather than degrading it. In this sense, one can envision the real correlation between a healthy ecosystem – a forest, a stream, a lagoon, a reef – with a healthy and thriving people. If one were to take this thought a step further, as the environment is degraded and biodiversity is lost, there is an equal erosion of living standard for a majority of the people, particularly in a nation where the majority leads subsistence lifestyles or is otherwise very low in the economic class hierarchy.

This chapter will then delve very briefly into the obstacles and challenges in the practical implementation of the many actions[84] of the FSM NBSAP. This is followed by an analysis of the effectiveness of the NBSAP, or more succinctly, an analysis of the effectiveness in implementation of the 11 themes, 11 strategic goals, and 35 objectives of the NBSAP by the institutions and people of the nation. Finally, this chapter will briefly look at the amount of domestic financial resources that the FSM puts forth toward the achievement of the NBSAP objectives on an annual basis, as well as the amount of international funding the federation is able to secure, with the chapter ending on a note on the way forward in terms of where the focus should be in order to successfully continue to implement the NBSAP as originally envisioned in 2002.

In review, the FSM NBSAP is a meticulously considered, well-crafted environmental policy document. It is rather broad in its reach and intended scope, covering a wide range of economic, social and environmental development processes, and thereby, is a rather valuable cross-sectoral policy tool for decision makers. As a guiding document for earnest ecological thinking within the context of economic development it serves its purpose well.

[83] The NBSAP and the National Strategic Development Plan, 2003-2024, (SDP) are the two primary national policy documents that guide the federation's sustainable development aims over the long term.

[84] There are 193 actions, or activities in the NBSAP.

2.2 Development of the NBSAP and status of its implementation

2.2.1 Development of the NBSAP in FSM

The second decade of the second millennium in human history may well be a quintessential opportunity to approach ecology issues from both the global and local perspectives. It very well may be the start of an epoch in which the phrase, *Act Locally Think Globally*, is in fact a guiding principle in development policy and discussion. Such an approach is in fact encapsulated in the 1992 Rio Declaration on Environment and Development, Principles 7 and 22, which state:

> *"States shall cooperate in a spirit of global partnership to conserve, protect, and restore the health and integrity of the earths' ecosystems. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command… Indigenous people and their communities and other local communities have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development."*

The FSM NBSAP was formulated during a 14-month period (January 2001 – March 2002), which comprised an extensive process of research, and multi-sectoral consultative activities involving a broad range of government (state, national and municipal), NGO, private sector and community stakeholders. The project was funded under the Global Environment Facility's (GEF) Enabling Activities that are administered by the United Nations Development Programme (UNDP). Overseeing the NBSAP Project is the FSM Environmental Management and Sustainable Development Council (SD Council). The SD council is an interdepartmental, intraagency advisory board established by the President and chaired by the Vice President of the nation. The SD Council established a working group called the NBSAP Panel to advise project management on implementation of the project. Each state designated a counterpart department to take on the responsibilities of coordinating the NBSAP activities for their respective action plans. In addition, several local and international consultants were engaged to undertake specific follow-up components of the NBSAP project. Throughout the consultative process an element of local capacity building was incorporated as a secondary objective of the project[85], and it was endorsed by the President and Congress in mid-March 2002.

[85] In fact, the eighth Theme of the NBSAP, Human Resource and Institutional Development, is by far the largest in terms of number of Objectives (5), and in the number of Actions (30).

The subsequent submission of the comprehensive FSM National Biodiversity Strategy Action Plan is the nation's primary effort to mesh the local and the global, while meeting its' obligations as a signatory to the Convention on Biological Diversity (CBD). The provisions of the Convention are set out in 42 articles, which clearly state the requirements that each ratifying nation needs to address. The elements of these articles relevant to the FSM have been addressed in the NBSAP.

National Environmental Management Strategies

In fact, the FSM NBSAP is an expanded and updated continuation of the nation's first documented environmental strategy: the National Environmental Management Strategies (NEMS) developed in 1993. As such, the NBSAP represents a continuum in the deliberate effort by the federation to adhere to the historical environmentally conscious principles present in the founding of the nation. The major strategies that emerged from the NEMS were:

- Integrate environmental considerations in economic development;
- Improve environmental awareness and education;
- Manage and protect natural resources; and,
- Improve waste management and pollution control.

These four strategies should thus be considered in the broadest context as the overriding aims of the environmental movement that currently exists in the FSM. Therefore, gauging any progression should be considered against these primary principles that exist in theme in all subsequent documents, inclusive of the NBSAP, as well as other policy documents that will be discussed in more detail below. For example, how well has the FSM been able to integrate environmental considerations into economic development? Has environmental awareness and education improved? Has the FSM been able to manage and protect natural resources? And finally, and crucially, has the nation been able to improve its waste management and pollution control in an effort to mitigate the delitrious effects of development upon biodiversity? How one is able to answer these questions is concommitant to how well the FSM has implemented the NBSAP.

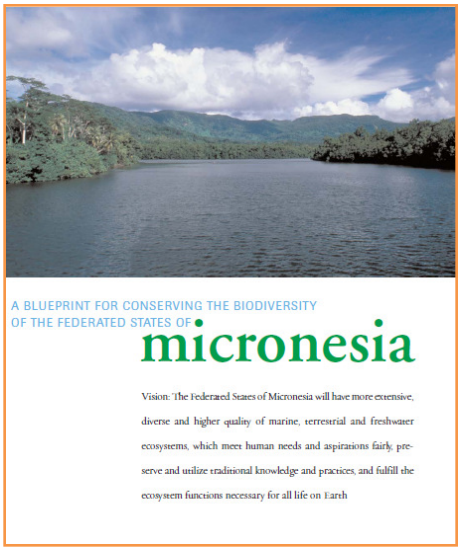
2.2.1 Status of NBSAP implementation

The FSM published its comprehensive National Biodiversity Strategy Action Plan (NBSAP) in 2002 through a widely participatory process to fulfil obligations under Article 6 of the Convention in Biological Diversity (CBD), which the nation signed in 1992 and the national Congress ratified in 1994. Along with being a natural extension and further refinement of the National Environmental Management Strategies (NEMS), dating back to 1993, it is also a document that included the essential environmental themes carried over from the nation's 2nd Economic Summit in 1999. In continuation, the major goals and themes of the NBSAP were subsequently integrated into the Environmental matrix of the FSM Strategic Development Plan (SDP), which itself serves as the overarching policy document developed in 2003 through the nation's 3rd Economic

Summit, an all-inclusive gathering of representatives from the nation's four State Governments of Kosrae, Pohnpei, Chuuk and Yap, the National Government, Civil Society or Non-Government Organizations (NGOs), including Women and Youth Groups, International Conservation NGOs, as well as Donor Countries and Development Partners. The FSM then took much of the strategy for environmental consideration and weaved it into the national government preorgative through the FSM-US Compact of Free Association as Amended, 2003-2024, whereby the Environment Sector is one of six sectors that receive priority funding over the next 15 years[86]. Integrating the provisions of the NBSAP into the SDP was a significant move by the FSM in terms of working toward integrating the 11 NBSAP themes throughout all sectors and further mainstreaming environmental considerations into this guiding policy framework for long-term development of the nation.

Moving on, in 2004 the FSM then carried out extensive stakeholder consultations to identify national capacity needs to implement the Strategies of the Convention on Biological Diversity, through the National Biodiversity Strategy and Action Plan Project – Phase II. The eleven biodiversity strategic themes contained within the FSM NBSAP were scrutinized through exhaustive assements across the range of ecosystems for Agrobiodiversty, Access and Benefit Sharing and Protection of Traditional Knowledge and In-situ Conservation and Initial Assessment and Monitoring, inlcuding Taxonomy[87]. At the same time, in 2004 the four states of the FSM completed what was known as the add-on phase of the NBSAP, completing state BSAPs through a participatory process for implementing the NBSAP at the local level according to specific cultural and environmental considerations (KBSAP, CBSAP, PBSAP, YBSAP 2004).

Blueprint for conserving the Federated States of Micronesia



Building on the momentum for conservation of biodiversity in the country, at about the same time the FSM was moving through the various phases of implementation of the NBSAP, it also undertook a historic conservation planning initiative, which ultimately yielded the seminal, *Blueprint for Conservation in the Federated States of Micronesia*, published in 2003. With the assistance of a diverse range of international support, including The Nature Conservancy and the U.S. Forest Service, the nation undertook a series of workshops and planning exercises (from June – October 2002) as part of what was ultimately a two-year process to identify 130 Areas of Biodiversity Significance, or what have come to be termed, ABS. These biologically rich sites combine unique and threatened ecosystems and species throughout the

[86] The six priority sectors under the Amended Compact are the Education, Health, Infrastructure, Private Sector Development, Environment and Public Reform.

[97] The eleven NBSAP strategic themes are Ecosystem Management, Species Management, Genetic Resources Use, Agrobiodiversity, Ecological Sustainable Industry Development, Biosecurity, Waste Management, Human Resources & Institutional Development, Resource Owners, Mainstreaming Biodiversity and Financial Resources. Status of implementation is laid out in the Table below.

federation and encompass 291,753 ha, or 19 percent of the FSM's entire terrestrial, freshwater, coastal and nearshore reefs and lagoon areas. It is the first effort of its kind – anywhere – to capture the collective biological knowledge of regional scientists and local experts and turn that knowledge into mapped focal areas for biodiversity protection. The NBSAP and the Blueprint for Conservation are closely intertwined in thematic content, with the Blueprint extending the strategic goals and objectives of the NBSAP into readily identified and achievable conservation actions by communities and governments within each of the states of the FSM, throughout all of its hundreds of islands.

Micronesia Conservation Trust

In 2002, the Micronesia Conservation Trust was established within the FSM, which is actually identified as Objective 4, under Theme 11 of the NBSAP, Financial Resources. MCT is the all-important funding mechanism that enables the continued implementation of the NBSAP and other relevant biodiversity work within the nation. MCT is established as a non-profit corporation with a governing board of nine members, including members from national, regional and international governments, NGOs, business and academic institutions. MCT has extrapolated on-the-ground conservation efforts in the FSM, as well as the ability of local conservation groups to secure consistent funding from a go-to source in terms of implementing many of the provisions of the NBSAP at the state level. This latter function cannot be underestimated. MCT also hosts the UNDP-GEF Small Grants Programme (MSGP) for the Micronesia sub-region; administers the NSA component of the Ninth European Development Fund, the Conservation and Environment Protection Programme (CEPP); co-coordinates the Pacific Islands MPA Community (PIMPAC); and hosts the Micronesians in Island Conservation (MIC) network, amongst other ongoing actions. MCT is likely the major piece in terms of the ongoing and future implementation of the NBSAP within the FSM and across the region (Palau, Marshalls, Guam and CNMI). The institution is currently working toward building a $20 million endowment to provide long-term support for biodiversity conservation efforts in the region, largely through the Micronesia Challenge (see below).

FSM Protected Areas Network

Additionally, 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, MCT, FSM Visitors Bureau, TNC, CSP, KCSO and YapCAP. The signatories to the FSM NISP have fully embraced the establishment

of the FSM Protected Areas Network (PAN). As such, 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, resulting in a range of actions such as a protected areas bill introduced 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 technical assistance and further the overall PAN effort and participation. 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 Biosphere Reserve.

Micronesia Challenge

Finally, the FSM internationalized its historic conservation ethos with the announcement – along with the leaders of the other Micronesian political entities of the Republic of Palau, Republic of the Marshall Islands, Commonwealth of the Northern Mariana Islands and Guam – at the Eighth Conference of the Parties to the Convention on Biological Diversity[88] of the Micronesia Challenge. The Challenge is a ground-breaking effort by the islands of Micronesia to set the stage for the rest of the world to follow to sustain unique biodiversity, ensure a healthy future for all people, protect unique cultures, guard pristine environments and ecosystems that are the foundations of future development, and to sustain the livelihoods of communities of people that is harmonious with nature. Moreover, the Challenge is expected to 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. The Micronesia Challenge is a statement by which the FSM will undertake an expanded commitment to preserve marine and terrestrial environments by e*ffectively conserving at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020*.

In summary, the FSM *has* progressed in its implementation of the principles laid out in the NEMS, and the continuing environmental, cultural and economic themes of the NBSAP. In some areas, it has made internationally renowned strides and pushed forward a fluid progression of ecological ideals and policy implementation, and in others, it has progressed very little, if at all. There are highlights and breakthroughs; and there are backslides and challenges, all of which are part of the national process of development. Below, presented in a table format for facility, is a more complete identification of the status of implementation for each of the specific actions of the NBSAP in FSM.

[88] It was at a high-level event held in March 2006 in Curitiba, Brazil

NBSAP implementation status (in table format)

Theme 1. Ecosystem Management

Strategy Goal	Objectives	Actions	Status of implementation
A full representation of FSM's marine, freshwater and terrestrial ecosystems are protected, conserved and sustainably managed, including selected areas designed for total protection.	1. Research and Monitoring: to undertake research and resource assessment/evaluation for the identification, documentation and monitoring of the FSM's ecosystems for the implementation of appropriate resource management programs, including conservation and protected areas.	a. Undertake comprehensive biological resource surveys of the nation's terrestrial, marine and freshwater biodiversity. b. Periodically obtain aerial photographs to update vegetation maps, document and evaluate land use practices and conditions of the aquatic environment. c. Develop and implement a long term monitoring program for all ecosystems within the nation to provide scientific information on the status of the nation's biodiversity through time. d. Develop priority research topics and monitoring techniques to be addressed, taught and utilized by all natural resource management agencies and relevant institutions. e. Publish all research and monitoring documents and develop a database available to the public. f. Develop and implement a program for monitoring the impact of biodiversity from Global Warming and Climate Change	a. Rapid Ecological Assessments on corals and fish have been conducted for all states for specific areas and islands; national forestry assessment conducted; some freshwater biodiversity studies, but still big gaps. b. Needs to be done for all states. c. There are monitoring programs for protected areas (MPAs), but not for all ecosystems within the nation. d. College of Micronesia has ongoing field research through summer internships in riparian, atoll and forest ecosystems. e. Research and monitoring documents are being published; COM-FSM is official clearinghouse, with state agencies as nodes; SPC also has an extensive FSM Environment Library. f. Development of program is in progress through the FSM Climate Change Policy 2009; monitoring of impacts on biodiversity needs to be integrated.
	2. Conservation Areas: to enhance the management of existing CAs and establish new CAs to achieve a full representation of the FSM's ecosystems.	a. Further develop and implement management plans for the existing marine and terrestrial conservation areas within the nation. b. Identify, develop, design and implement management plans for new aquatic and terrestrial conservation areas within the nation, especially in areas that are currently poorly represented, contain unique habitats, or have high levels of threats. c. Integrate all management plans and protected area programs with community/resource owner participation activities including enforcement.	a. Management plans are being developed and implemented, largely by conservation NGOs. b. Ongoing stages of Mgmt. plans in Kosrae for the Utwe Biosphere Reserve, Olum Watershed and the Yela Protected Area; in Pohnpei for the Watershed Forest Reserve and the Ahnd Atoll Biosphere Reserve; in Chuuk for Epinup Protected Area and Chuuk UFO; there are also plans developed for Enipein, Senpehn and Pwudoi mangrove reserves in Pohpei. c. NGOs are undertkaing this, particularly for the MPAs in Pohnpei (CSP) and in Utwe, Kosrae (KCSO).

		d. Incorporate large conservation areas to include more than one ecosystem (e.g. mangroves, seagrass beds, lagoon systems and barrier reefs). e. Further develop an appropriate information system (e.g.: Geographical Information System) to store and share information on ecosystems and conservation areas. f. Continue to develop and refine the Ecoregional Conservation Planning process for the nation and implement recommendations. g. To identify and conserve critical watershed areas. h. Develop and implement programs for the restoration of degraded aquatic and terrestrial ecosystems, prioritizing those of endemic, endangered and threatened species. i. Develop and implement conservation of biodiversity in important natural and cultural heritage sites throughout the nation (e.g. Nan Madol – Pohnpei State).	d. Currently being attempted in specific areas of Pohnpei, Yap, Kosrae and Chuuk. It is ongoing. e. NGOs and Government agencies working together throughout FSM on this; more work needed in this area. f. This is ongoing through the Micronesia Challenge initiative. g. Critical watershed areas (ABS) in all states have been identified and contained within the Blueprint; conservation efforts are still ongoing. h. This remains largely to be accomplished, particularly for the restoration of ecosystems; some work has been ongoing with species, particularly certain economically valuable marine species such as giant clams, sponges, corals, etc. that are being aquacultured. i. This remains to be accomplished.
	3. Sustainable Use of Ecosystems: to develop and implement effective management programs that promotes income-generating activities and use of biodiversity resources sustainably within all FSM's ecosystems.	a. Finalize, implement and enforce ecosystem management plans through legislation. Special enforcement actions are required to eliminate destructive practices (e.g. dynamite fishing). b. Develop guidelines and protocols for the sustainable use of the nation's biodiversity through activities (e.g. eco-tourism, non-timber forest products and mariculture). c. Undertake economic valuations of ecosystem services for terrestrial, aquatic area use. d. Increase the number of mooring buoys located within designate marine areas in each State for large vessels, especially the tuna fishing fleet.	a. Enforcement of ecosystem management plans and various laws and regulations is mandated, but remains a central challenge; dynamite fishing in Chuuk is being pursued through special enforcement actions, but problem persists. b. FSM Sustainable Development Plan (2003) provides guidelines for such activities; FSM Dept. of R&D follows to assist states in promoting sustainable economic and environmental activities; grants from MSGP, MCT, EU CEPP. c. These valuations have yet to be completed. d. An important action that remains to be instigated and completed.

Theme 2. Species Management

Strategy Goal	Objectives	Actions	Status of implementation
FSM's native, endemic, threatened, and traditionally important species are protected and used sustainably for the benefit of the people of the FSM and the global community.	1. Conservation of Species: to preserve and conserve all native, endemic, threatened, and traditionally important species in the FSM through effective conservation programs.	a. Establish, maintain and update a threatened species list. b. Review existing lists of threatened species in peril and develop and implement appropriate conservation programs. Determine which species are suitable for ecovery/reintroduction programs (including propagation) and develop and implement such programs. c. Further develop State botanical gardens to house collections of native flora. d. Investigate the potential and feasibility of developing captive breeding programs to prevent species extinctions. e. Work with other countries to further develop and implement regional and international programs to protect migratory species (e.g. Turtles). f. Further develop and strengthen endangered species laws and regulations. g. Develop and implement programs for the conservation and protection of native species and varieties from the destructive impact of alien and invasive species.	a. FSM Threatened Species List exists, but likely needs to be updated. b. Not comprehensively happening, although there are some actions being taken – e.g., giant clam and coral raising and protection of last freshwater *Terminalia carolinensis* forest; there are also turtle tagging programs ongoing in Lamotrek and Elato in Yap; list should be reviewed and further actions taken. c. An important resource for preserving agricultural biodiversity in FSM is the genebank field collection kept at the FSM Pilot Farm, Pohlangas, Madolenihmw, Pohnpei, where there are 69 giant swamp taro, 32 banana, 14 pandanus, and 13 breadfruit accessions; Pohnpei also has a Public Botanical Garden managed by the PVB, and COM Pohnpei Campus has a small show-case garden that houses native plants. d. Clams, sponges and corals are now being bred in captivity; there are also attempts to breed mangrove crabs in captivity. e. YapCAP is working in Ulithi (Lamotrek & Elato) on a long-term turtle tagging project. f. Remains to be accomomplished. g. SAPs have been developed for every state IST (PIST, KIST, CIST, YIST)
	2. Research and Monitoring: to undertake research for the identification, documentation and monitoring of species contributing to the implementation of appropriate conservation and management programs.	a. Undertake research programs to complete the identification and current status of the nation's flora and fauna. b. Establish and implement resource-monitoring programs for species that are threatened, rare, endemic, commercially harvested and culturally significant. c. Develop a central location within each State that will house all findings and distribute them to interested parties.	a. Research is ongoing, particularly with native plants in Pohnpei and Kosrae; there are other scattered studies as well throughout FSM; more work needs to be done in this area however. b. There are currently monitoring programs for trochus (in sanctuaries). c. Each state has nodes that act as NBSAP clearinghouse, generally the state EPAs. d. There are some ongoing monitoring programs, including watershed forest activities in Pohnpei,

		d. Develop monitoring programs to evaluate, document, and implement appropriate actions on all possible threats to the biodiversity of the nation. e. Support and develop a monitoring program to evaluate the impact of coral bleaching and crown of thorns starfish on coral reefs. f. Develop research and monitoring programs to identify the presence and evaluate effects of invasive species and develop eradication programs where appropriate.	fish market surveys, MPAs, fish and coral counts. e. Resource agencies and conservation NGOs have ongoing monitoring programs that take these factors into account. f. Invasive species control workshops and in-situ control programs are ongoing throughout the FSM; rat eradication in Madolenihmw, Pohnpei and Mile-a-minute eradication in Kosrae are good examples; also see Objective 1 (g) above.
	3. Sustainable Use and Management of Species: to ensure the sustainable use and management of species for social and economic development.	a. Reevaluate and/or develop appropriate sustainable management plans, including sustainable harvesting levels and enforcement programs for all commercial and subsistence harvested marine (inshore and offshore), freshwater and terrestrial flora and fauna. b. Through legislation and enforcement eliminate all destructive harvesting practices (e.g. dynamite and fish poisoning fishing). c. Develop and implement native forest regeneration and rehabilitation programs. d. Develop and encourage environmentally sustainable and economically viable aquaculture and forest product programs. e. Identify and implement suitable sustainable use management programs for species that are important for the eco-tourism industry (e.g. game fishing, manta ray observations and mangrove forest tours). f. Provide technical, financial and marketing support and assistance for all environmentally sustainable development. g. Establish environmental certification "green products" for natural resource export by the private sector at sustainable levels (e.g. marine aquarium council certification and forest stewardship certification).	a. Although there are efforts in this regard, much remains to be accomplished. b. Legislations have been drafted and passed in all states; enforcement remains a constraint. c. Some NGOs (KWA and WWA) have been active in this area (e.g., replanting of native mangrove species.) d. This has been developed and supported throughout the FSM, headed from the national level by Dept. of Resources and Development. e. These actions are proceeding successfully, largely through the private sector (hotel operators) and the conservation NGOs. f. Some effort from the national government has been achieved in this regard (MCT. MSGP, CEPP), however, more work is required here, particularly at the state level; some foreign development partners also have been instrumental (Australia, New Zealand, EU and Japan are good examples.) g. There is no environmental certification pe se for "green products"; national and state governments currently oversee this action; this has yet to be established.

Theme 3. Genetic Resource Use

Strategy Goal	Objectives	Actions	Status of implementation
The FSM's genetic resources are accessible for utilization and all benefits derived are equitably shared amongst the stakeholders.	1. Equitable Sharing of Benefits of Genetic Resources: to develop and implement appropriate National and State legislation and measures to effectively access genetic resources and carry out fair and equitable sharing of benefits from the use of these resources.	a. Develop National and State bioprospecting legislation. b. Develop National and State bioprospecting enforcement programs and penalties. c. Develop and implement appropriate benefit sharing mechanism and legislation for all holders of traditional knowledge and owners of resources utilized in bioprospecting. d. Clearly define through appropriate legislation intellectual property rights. e. Establish a bioprospecting-coordinating national expert panel. f. Develop, implement and enforce a scientific code of conduct for all biodiversity and bioprospecting research in the FSM. g. Develop a research permit process that include provisions for hiring local associates in order to assure that local capacity is developed and supported in conjunction with research on genetic resources. h. Develop a system for tracking biodiversity research in the nation. i. Establish a process for permitting the collection of biological specimens needed for scientific studies in order to comply with international regulations on the transport of biological specimens as well as to control biopiracy.	a. National legislation being developed; state legislations are lagging behind. b. Enforcement programs and penalties are not yet in place; awaiting passed legislations. c. An official mechanism does not yet exist, however, each state does have cultural mechanisms in place; legislations are not yet in place. d. Intellectual property right laws are still being developed. e. This panel exists in the form of the Sustainable Development Council; may need additional membership to accomdate this area. f. Remains to be accomomplished. g. Research permit process does not as yet exist; however, national government does have protocols in place whereby capacity is developed locally; there remains work to be done. h. Biodiversity research goes through FSM Dept. of Resources and Development, as well as Office of Environment; the SD Council also acts as a conduit for such information and research. i. FSM Dept. of R&D has a process in place; may be a need to review and strengthen.

Theme 4. Agrobiodiversity

Strategy Goal	Objectives	Actions	Status of implementation
The conservation and sustainable use of Agrobiodiversity contributes to the nation's development and the future food security of the FSM.	1. Conservation and Sustainable Use of Agrobiodiversity: to develop and ensure the effective implementation of appropriate conservation measures for the sustainable use of agrobiodiversity.	a. Promote methodologies for sustainable use of agrobiodiversity. b. Eliminate unsustainable agrobiodiversity use. c. Establish incentives that encourage conservation and sustainable use of agrobiodiversity. d. Promote environmentally sound agricultural practices (e.g. organic farming, agroforestry and polyculture). e. Promote, develop and share environmentally sustainable agricultural practices. f. Identify, develop and establish botanical gardens featuring local endemic, endangered and threatened species. g. Identify, promote and enhance existing programs for the inventory, propagation and preservation of traditional species, varieties, cultivars and breeds.	a. Methodologies are being promoted by national and state governments, along with help from local NGOs, TNC, NYBG, and SPC. b. Same as above, although unsustainable use has not been eliminated. c. Government incentives do not as yet exist; cultural incentives remain strong. d. National and state governments are promoting these practices. e. Again, this is being promoted; currently Sustainable Land Management program underway whereby all states sharing successes and lessons learned. f. Pohnpei has a botanical garden, but struggles to progress due to funding constraints; no other states have botanical gardens in place. g. Ongoing through National Tissue Culture lab in Kosrae, as well as with private sector, NGOs and state and national government programs.
	2. To compile existing research findings and develop programs and projects critical to the development of agrobiodiversity.	a. Document existing traditional agrobiodiversity resources and practices, including the usage of aerial photography. b. Develop and expand on existing markets for local species and varieties that can be produced on a sustainable basis. c. To promote existing research findings with farmers through training programs and public education.	a. This has been documented, but likely outdated and in need of updated aerial photography. b. Farmer's Association's in the states are promoting this activity. c. State Farmer's Associations working with government and communities on this.

	3. New Research and Development: to conduct relevant research critical to the development of agrobiodiversity.	a. Evaluate the usefulness and impacts of new biotechnologies. b. Document existing traditional agrobiodiversity resources and practices, including the usage of aerial photographs. c. Develop and expand on new markets for local species and varieties. d. Develop and implement research and development training programs for all relevant agencies and institutions involved in agrobiodiversity. e. Document and publish all research information and findings and maintain collections of information in each State. f. Conduct research on the ecology of traditional agricultural methods.	a. NA – not enough information available. b. Existing practices well-documented and readily available – recent publication, *Pohnpei Ethnobotany…* an excellent new resource. c. Private sector is leading the way on this, including private local food markets within the states; national government supporting aquaculturing of clams and corals. d. College of Micronesia and FSM Dept. of R&D facilitate ongoing training programs; state agricultural agencies also involved. e. Research information in this area should be maintained in relevant respective government agencies throughout FSM; NGOs (e.g., IFCP) also working in the FSM to maintain collections. f. Research in this area has largely been led by YINS in Yap; M. Balick (NYBG) and Collaborators have also been conducting research in Pohnpei; more such work could be useful.
	4. Food & Health Security: to enhance and strengthen food and health security through the use of sustainable agrobiodiversity practices.	a. Develop and implement new and existing programs that promote the production of local nutritional food. b. Develop and implement programs that increase local food production and enhance agrobiodiversity. c. Encourage sustainable breeding programs for livestock (e.g. pigs and chickens)	a. DSAP program through Dept. of R&D, as well as IFCP (NGO) are forwarding this action. b. DSAP program through Dept. of R&D, as well as IFCP (NGO) are forwarding this action. c. Depts. of R&D at both national and state level are advancing this; cultural norms also promoting this activity in communities.

Theme 5. Ecological Sustainable Industry Development

Strategy Goal	Objectives	Actions	Status of implementation
Economic development activities in the FSM meet the needs of the population while sustaining the resources for the benefit of future generations.	1. Ecologically Sustainable Industries: to develop long-term ecologically sustainable industries that provides attractive incomes while minimizing the exploitation and impact on natural resources.	a. Promote the development of ecologically sustainable and economically profitable enterprises utilizing and conserving the nation's biodiversity and utilizing economic incentives (e.g. tax breaks) to promote expansion of these activities while removing all incentives for non-compliant industries. b. Promote and support research and pilot programs that develop partnerships between the government and private sector to develop ecologically sustainable industries. c. Further develop and support those industries currently meeting ecological sustainability goals (e.g. Eco-tourism). d. Develop and implement mechanisms for the establishment of National and State "green" accounting programs, including incentives. e. Establish incentive based programs for "environmentally friendly" community development, including economic incentives and financial access for these activities. f. Develop and implement environmental economic valuation procedures for assessing the full economic value of biodiversity to the nation. g. Integrate biodiversity valuation as an integral component of all land use and coastal use planning. h. Explore and develop a program that introduces a user fee program for conservation areas to provide additional funding assistance for the management of these areas.	a. Incentives and disincentives for the promotion of ecologically sustainable industry are simply not occurring; in fact, it may be the opposite. b. Not comprehensively happening, although there are some actions being taken – e.g., giant clam and coral farming for export as a partnership between private sector and national government. c. Support by government to eco-friendly businesses needs to be improved; KVR in Kosrae is a good example. d. These mechanisms are not yet established. e. This action is being led by the NGOs; Micronesia Conservation Trust a big factor. f. Remains to be accomomplished. g. State and national governments do make this consideration, however, usually community needs and money takes precedence so this can be improved. h. User fees for conservation are not well established yet; some NGOs are beginning to implement such fees for conservation areas.
	2. Income Generating Activities: to develop and promote long-term ecologically sustainable income generating activities for resource owners and the community.	a. Identify and implement appropriate programs to promote and support sustainable income generating activities at the community level and provide financial incentives and capacity building to assist in the development of these	a. This action is being led by the NGOs of the FSM; government can do more in terms of support and incentives. b. Government has established a Division of Overseas Development Assistance to

		programs. b. Establish and strengthen networks and partnerships between public and private sectors including donor agencies to support sustainable income generating activities. c. Undertake evaluations of feasibility and ecological sustainability of all proposed income generating activities. d. Develop mechanisms to derive income and develop capacity from eco-education and eco-research industries.	coordinate and support this action. c. MERIP feasibility study of mariculture in MPAs in Yap, Kosrae, and Chuuk funded by the EUCEPP. d. These mechanisms are not yet complete; there have been some working groups established at the national government to pursue an Instititute of Natural Resources and Renewable Energies at the College of Micronesia; MMMR in Kosrae is working toward establishing a research station to culture and sell aquarium fishes; MERIP in Pohnpei (NGO) is another mechanism.
	3. Energy Resources: to secure long-term efficient and sustainable energy sources that promotes the use of technology contributing to energy conservation and the protection of biodiversity.	a. Promote and support environmentally sound development of natural energy sources at all levels of the nation and including National and State strategies for energy safety and efficiency. b. Promote renewable energy resources and provide incentives for their use. c. Promote and provide technical information to develop alternative energy sources using solar, wind, water and hydrogen cells for power generation. d. Promote technology that contributes to energy conservation. e. Develop management plans to allow sustainable use of the nation's forests for energy sources, especially mangrove forests. f. Reduce reliance on wood as fuel. g. Reduce green house gas emissions.	a. National and state governments (President and Governors) are actively pursuing renewable energy and energy efficiency applications. b. So far, no incentives are in place, but FSM currently finalizing National Energy Policy. c. National government (R&D) has hired an Energy Advisor for this action; EU CEPP-MCT-MicSem project also promoting this activity. d. Government and private sector are working toward this action; GES (RE Company) is actively promoting this action. e. CSP in Pohnpei doing some work; KIRMA in Kosrae; YINS in Yap working on this action; further effort required. f. Wood is still heavily used as a fuel source, most especially for those in the lower income scale. g. Negligable for FSM: yet more and more cars are imported each year and reefs and seagrass meadows – carbon sinks – are being destroyed.

Theme 6. Biosecurity

Strategy Goal	Objectives	Actions	Status of implementation
Border control, quarantine and eradication programs are effectively protecting the FSM's native biodiversity from impacts of alien invasive species.	1. Policy and Legislation: to improve and strengthen appropriate National, State and Municipal policies and legislation to ensure the effective management of Biosecurity.	a. Develop National and State policies and actions for the management of all Biosafety issues. b. Develop National and State policies, legislation and actions for the management of genetically modified organisms. c. Further develop and implement National and State laws and screening processes for alien species introductions and genetically modified organisms to manage or minimize their impacts on the nation's biodiversity. d. Further develop the National Government's power to enforce (including issues of transportation and staffing) all laws and legislation relating to alien introductions.	a. National and state policies well established and coordinated, with assistance from donors. b. These policies are not yet in place. c. Laws are well developed and processes in place for alien species; GMOs are not as well known or recognized – more effort required on this component. d. This – crucially – has yet to be developed.
	2. Control and Eradication: to identify and develop appropriate programs to ensure effective control and eradication of species threatening biodiversity.	a. Strengthen facilities and provide informed and trained personnel for border control and quarantine services. b. Develop programs for the control and eradication (where feasible) of invasive species. c. Develop programs for the control of all endemic species being exported from the nation. d. Further develop screening protocols for all international watercraft entering the nation's ports and traveling within the nation. e. Organize invasive species task force and develop rapid response plans in each State. f. Further develop screening of all domestic watercraft operating between ports within the nation. g. Implement regional and international programs to protect native marine biodiversity on the high seas and all coastal ports (e.g. PACPOL and IMO programs).	a. Facilities and training of personnel are up to date and ongoing improvements being made. b. FSM Dept. R&D leading this effort and programs being developed and implemented. c. There are programs in place; more effort required to ensure endemic fruit bats in particular are no longer exported. d. NA – not enough information available e. Invasive species taskforce established with rapid response plans developed for each state. f. NA – not enough information available. g. NA – not enough information available.

	3. Research & Monitoring: to undertake a systematic and scientific research monitoring program to allow management of Biosecurity threats.	a. Review, evaluate, update and prioritize the lists of terrestrial and aquatic invasive species in the FSM. b. Strengthen the National and State government agencies to be able to undertake appropriate scientific research and assessment of introduced species. c. Increase collaboration with regional and international agencies to assist in the identification, control and eradication of invasive species.	a. National government and international partners are undertaking this task. b. Reasearch and assessment being conducted by local experts. c. This is occurring, noteably with SPC.

Theme 7. Waste Management

Strategy Goal	Objectives	Actions	Status of implementation
All human-generated wastes are effectively managed to prevent or minimize environmental degradation, pollution and loss of the nation's biodiversity.	1. Solid Wastes and Sewage: to provide an environmentally safe mechanism for the collection, storage and disposal of solid wastes and sewage within the nation to prevent further degradation of the environment and loss of biodiversity within the nation.	a. A technical assistance program will be developed and implemented to fund necessary infrastructure (e.g. water systems, refuse dumps, recycling facilities, sewer systems and treatments plants) to assure the health and welfare of all FSM inhabitants. b. Develop and implement waste collection, storage and disposal programs for residential and commercial premises in the main urban centers. c. Develop and implement programs for reuse and recycling of wastes, both within and outside the country. d. Develop and implement waste management programs that prevent contamination of freshwater (including ground water lens and coastal marine environment) from dumpsites. e. Develop and implement sewage treatment programs and redevelop marine sewage discharge locations to limit negative impacts on the marine environment.	a. This action is currently ad-hoc throughout FSM; there are US, ADB, Japan – funded actions ongoing through national government, however, no real coordination exists. b. No government imposed programs; private sector is mostly doing this (e.g. PWMS in Pohnpei); most states do not have any waste collection program in place. c. Kolonia Town alluminum recycling program; Kosrae can recycling program; CWC recycling program in Weno; several national recycling initiatives in the planning stages now. d. Kosrae has developed a central landfill toward this end with assistance from Japan; efforts to expand to other states are underway. e. Although there are donor-funded (e.g., ADB and U.S. Compact) programs, they are still on the shelf and no action is being taken in this regard as of yet; for marine sewage discharge locations, redevelopment has not yet occurred.

	2. Petrochemicals: to provide an environmentally safe mechanism for the collection, storage and disposal of petrochemical wastes to prevent degradation of the environment and loss of biodiversity within the nation.	a. Develop and implement waste collection, storage and disposal programs for residential and commercial premises throughout the nation. b. Develop and implement programs for reuse and recycling of petrochemical wastes. c. Develop and implement monitoring legislation and enforcement of petrochemical pollution, including ship waste dumping in open waters. d. Develop and implement programs for the safe collection and disposal of petrochemical wastes resulting from shipwrecks.	a. There are currently no organized programs for such; however, in Pohnpei, Kosrae and Yap, there are informal methods in place as to where people can bring such materials for disposal. b. No such programs have been developed. c. None – crucially – have been implemented to date; a serious issue that needs to be addressed. d. No such programs exist; however, Yap has had experience and may have some rudimentary system in place as a result; private sector in Pohnpei can act quickly as well, however, for safe disposal of waste, there remain no programs in place.
	3. Hazardous Chemicals: to provide an environmentally safe mechanism to prevent or eliminate the use and abuse of hazardous chemicals and to develop and implement correct storage and disposal programs to prevent the degradation of the environment and loss of biodiversity within the nation.	a. Develop and implement waste collection, storage and disposal programs for residential and commercial premises throughout the nation. b. Develop and implement programs for the importation, handling, use and safe disposal of hazardous wastes (including lead batteries, pesticides, fertilizers, and chlorine) both within and outside the country. c. Develop and implement monitoring legislation and enforcement programs to prevent unauthorized use and misuse of hazardous chemicals including incorrect storage and disposal. d. Revise and further develop legislation and regulations of hazardous chemicals, including importation requirements.	a. No such programs exist as yet. b. No such programs exist as yet. c. No such programs exist as yet. d. NA – not enough information.

	4. Pollution Emergencies: to enhance the nation's capability to effectively respond to pollution emergencies to reduce negative impacts on the environment.	a. Increase preparedness and skills of the relevant government and private sector agencies and acquire equipment required to rapidly respond to petrochemical spills and other hazardous chemical emergencies, both within the lagoons and in the open ocean. b. Enhance and strengthen the links between National, State and Municipal governments with regard to coordination and response to petrochemical spills and other hazardous chemical emergencies. c. Develop and implement legislation to require all polluters (governmental and private) to clean up and/or pay for damages occurred by polluting the environment.	a. National government and U.S. FAA have been collaborating on this action; more effort should be undertaken. b. Again, same as above. c. No such legislation has been developed.
	5. Air and Noise Pollution: to provide an environmentally safe mechanism for the reduction of all activities that degrades the atmosphere and associated biodiversity.	a. Develop and implement air and noise quality monitoring programs for residential and commercial premises throughout the nation. b. Revise and further develop legislation and regulations to effectively reduce air and noise pollution within the nation. c. Develop and implement monitoring and enforcement of air and noise, light and thermal pollution legislation.	a. No action in this regard has occurred. b. No action in this regard has occurred. c. No action in this regard has occurred. NOTE: this is a crucial area that should be addressed, particularly as the urban (and rural) areas become more inundated with noise and pollution from industry, traffic, construction and a more western lifestyle.

Theme 8. Human Resources and Institutional Development

Strategy Goal	Objectives	Actions	Status of implementation
All citizens, residents and institutions of the nation are aware of the importance of biodiversity and have the technical knowledge, skills and capability to conserve, preserve and sustainably utilize, manage and develop all biodiversity within the nation.	1. Human Capacity Building: to develop and strengthen the capacity of resources owners, traditional leaders, communities, technical staff and policy makers in the coordination and implementation of conserving, preserving and sustainably utilizing and developing the biodiversity of the FSM.	a. Develop and implement local capacity training programs for National, State and Municipal personnel involved in the formation and implementation of conservation related programs, including education and enforcement sectors. b. Develop and implement capacity building training for local communities, resource owners and traditional leaders on the principals and benefits of Environmental Impact Assessment (EIA), so EIA activities can be applied to development projects at community levels. c. Secure and seek financial assistance to develop and implement capacity development programs for all sectors. d. Require all visiting researchers and research agencies to hire local individuals to assist in all program activities. e. Require grant-funding agencies to include local individuals to assist in the preparation of program documents. f. Develop and implement local capacity building and strengthening programs on biological surveys, monitoring techniques and ecosystem management. g. Establish multi-sectoral groups of local experts to co-ordinate and undertake biological surveys and monitoring programs, seek outside assistance when necessary. h. Provide and implement local training programs on community based conservation management approaches, methodologies and the development of sustainable income generating activities. i. Provide training and capacity building for	a. Institutional strengthening and capacity building is ongoing within governments at the highest levels; Micronesia Challenge Regional Office and Steering Committee, MIC at national level, PIMPAC/LMMA at technical manager level; NGOs also involved with this action in terms of organizational management; MSGP/TNC have conducted SAPs and board trainings for a host of government and NGO groups in all the FSM states. b. This action has not yet been implemented fully. c. Financial assistance has and continues to be secured for ongoing capacity building in government, NGOs and communities. d. Currently not required, however protocols in place that generally achieve this action. e. Currently not required, but again, there are internal practices that accommodate this action. f. Some action, mostly by NGOs, ongoing; LMMA, MIC, FSM PAN, CBO and NGO SAP actions are integral components. g. FSM PAN, State. Govs., NGO's, PIMPAC, LMMA are good examples in FSM. h. Some work has been done between municipal governments and NGOs; action largely not achieved as of yet. i. CSP in Pohnpei is currently working on this action.

		communities on their legal rights and appropriate procedures for reporting environmental offences. j. Undertake capacity building training for National and State personnel on genetically modified organisms and their possible effects on the nation's biodiversity. k. Undertake capacity building training for quarantine personnel (National and State) on border control, quarantine services and the effective screening of new species introductions and necessary eradication of potentially invasive species. l. Develop and implement training programs to enhance and strengthen public and community knowledge of the understanding, awareness and commitment to sustainable agricultural practices. m. Provide training on proposal development and strengthen human capacity to seek and acquire outside funding assistance. n. Develop and implement local capacity building and strengthening programs on correct waste management usage and disposal, including removal of hazardous waste products (e.g. machinery and toxic products) and recycling. o. Develop and implement local capacity building and strengthening programs on alternative ecologically friendly industries and energy conservation and management.	j. Action not completed. k. Capacity building in this area is ongoing through trainings and workshops. l. This has largely been undertaken by the NGO IFCP, and the EU-SPC DSAP programme. m. MSGP (UNDP-GEF) programme and MCT (EU CEPP) have moved on this action – ongoing. n. There may be some, yet this remains an action to be completed more fully. o. Some effort has been instigated in this regard through the EU-REP5 and CEPP (EDF9) programmes, facilitated by FSM national government; expected to continue under EDF10.

	2. Institutional Strengthening: to develop and strengthen the capacity of National, State and Municipal government agencies, NGO's and academic institutions in the coordination, education and implementation of activities for conserving, preserving and sustainably utilizing the biodiversity of the FSM.	a. Develop and implement institutional strengthening training programs for National, State and Municipal government agencies, educational institutions and NGO's involved in the formation and implementation of conservation related programs. b. Develop and implement institutional strengthening programs for all National, State and Municipal government agencies on the principles, benefits and enforcement of Environmental Impact Assessment (EIA). c. Secure and seek financial assistance to develop and implement institutional strengthening programs for all sectors. d. Strengthen the ability of the National and State agencies, education institutions and NGO's to provide and implement local educational training programs to all citizens on community based conservation management approaches, methodologies and the development of sustainable income generating activities. e. Strengthen the capacity of National, State and Municipal government agencies, education institutions and NGO's to develop a mechanism to integrate traditional and modern conservation management practices to further improve the agrobiodiversity of the nation.	a. This activity is being carried out successfully; MSGP and MCT are conducting most of this work across the FSM (also see Objective 1, Action a above.) b. MSGP and CEPP have been active in developing this action, with MSGP assisting in over 19 SAPs and CEPP making 14 grants. c. See b above. d. PIMPAC and LMMA exist and need COM-FSM Marine Science Program to link. e. COM-FSM has several extension programs ongoing in this area.
	3. Public Awareness and Education: to promote, encourage and strengthen the awareness and understanding of all stakeholders (local resource owners, traditional leaders, communities, government agencies, academic institutions, NGO's and policy makers) of the importance of protecting, preserving and ensuring sustainability of the biodiversity of the FSM.	a. Develop, promote and conduct public awareness campaigns and programs though media, workshops/seminars and information material for National and State government agencies, municipal councils and relevant targets groups including resource owners on the functions and benefits of conserving and sustainable utilization of the nation's biodiversity. b. Integrate information on traditional knowledge and promote traditional practices that are important for the conservation and sustainable use of biodiversity into the education curriculum.	a. Some organized awareness campaigns ongoing such as Rare Program; TNC/MIC did have a dedicated Media Coordinator until 2006; MC has a full-time Media Specialist as well as the MC Young Champions group and the MC Regional Coordinator (also see Objective 1 above.) b. Some public schools incorporate such curriculum; more work required. c. This action as yet to be meaningfully achieved. d. Sporadic and ad-hoc at best; requires action. e. FSM conservation NGOs are largely undertaking this action in the states; state EPAs also conduct public awareness as a matter of annual activity.

		c. Increase coordination and networking between relevant National and State agencies to better utilize information on the FSM's biodiversity for use and integration into school and college curricula, youth and development programs. d. Develop and distribute public awareness material on all legislation relating to biodiversity use to all stakeholders in the nation's official language (English) and translated into each State language. e. Develop and implement public awareness and educational programs on the importance and management of all ecosystems, native and other important species and agrobiodiversity. f. Develop public awareness programs to increase the knowledge and appreciation of the functions and benefits of biodiversity. g. Develop and implement National and State public awareness programs for invasive species to prevent illegal introductions and encourage control. h. Increase public awareness, education and acceptance of correct sanitation practices, waste disposal mechanisms and pollution programs. i. Increase public awareness, education and acceptance of correct ecologically sustainable industry development and energy usage, including alternative energy options (e.g. solar and wind). j. Develop a National and State clearinghouse mechanism for disseminating and sharing information on biodiversity activities.	f. Conservation NGOs are conducting these campaigns in the public schools (e.g., CSP and KCSO with Green Road Show program.); EU CEPP funded-projects also contributing. g. Ongoing activity: most recent publication is the Invasive Weeds of Pohnpei; each state also has effective established Invasive Species Task Forces. h. State EPAs – KIRMA in Kosrae a good example – undertaking this action. i. As far as industry, this action is largely unaccomplished; for RE, there have been excellent recent actions ongoing (e.g., EDF9 and 10) j. FSM-COM is the designated national clearinghouse mechanism with the State EPAs designated as the clearinghouse nodes; mechanism for actual dissemination and sharing of information to public and policy makers may not be as well developed as can be.

Theme 9. Resource Owners

Strategy Goal	Objectives	Actions	Status of implementation
Traditional resource owners and communities are fully involved in the protection, conservation, preservation, and sustainable use of the nation's biodiversity.	1. Traditional Knowledge, Practices and Innovations: preserve traditional knowledge and practices of the cultures of the FSM that are important for the protection, conservation, preservation and sustainable use of biodiversity.	a. Develop a register to document and preserve all traditional knowledge, practices and innovations important for the conservation of biodiversity. b. Develop suitable National and State legislation to protect traditional knowledge, practices and innovation and provide a mechanism for benefit-sharing to appropriate knowledge holders. c. Develop programs that integrate traditional knowledge, practice and innovation with modern scientific technology and methodologies to promote conservation and sustainable use of biodiversity.	a. Register for FSM does not exist; sporadic publications have been published documenting traditional practices; NYBG is documenting such practices in FSM currently. b. This action has not yet been implemented. c. There are some areas (e.g., Fefan, Chuuk and Kaday Community in Yap) where traditional knowledge and modern methodolgies are being integrated toward conservation.
	2. Empowering Resource Owners: empowering resource owners and communities to conserve and sustainably manage biodiversity under suitable customary and modern resource management practices.	a. Develop and implement programs for resource owners, traditional leaders, communities and municipalities to be responsible for the conservation and sustainable use of biodiversity. b. Integrate activities and programs that promote the conservation and sustainable use of biodiversity into relevant government agency extension services. c. Further develop and encourage the full participation of all resource owners and community groups in the formulation, coordination and implementation of programs for the conservation and sustainable use of biodiversity. d. Establish an incentive scheme to encourage environmentally friendly communities/municipalities that promote conservation and sustainable use of biodiversity. e. Develop appropriate legislation at the State and Municipal levels that encourages the empowerment of resource owners and communities to monitor and enforce environmental regulations.	a. There have been some undertaken as part of this action: Utwe Biosphere Reserve in Kosrae; Oroor, Fefan in Chuuk; Nimpal Channel in Yap; and Enipein in Pohnpei, to name a few. b. NA – not enough information. c. Kaday in Yap is a good example in FSM where this is occurring. d. One such scheme is being implemented with the Yela Environment Landowners Authority in Kosrae through the region's first Conservation Easement; it will be a precedent and should help ratify other such efforts around the nation. e. Action as yet to be fully implemented.

Theme 10. Mainstreaming Biodiversity

Strategy Goal	Objectives	Actions	Status of implementation
All economic and social activities of the FSM take full account of impacts on and fully consider sustainability of biodiversity.	1. Population: to enhance understanding of links between population and our islands' carrying capacity.	a. A program will be developed to link data on population, natural resources and biodiversity to sustainable development. b. Indicators of sustainable development will be developed and monitored. c. A public awareness program on the links between population density, natural resources, biodiversity and prospects for sustainable development will be implemented. d. Public Health programs will support responsible parenthood. e. An immigration policy will be established.	a. Program has not been developed. b. No such indicators exist; what would these indicators be? What would they indicate? What factors would be considered? c. No such program has been developed or implemented; various national reports do however consistently link high population density/growth with a decrease in biodiversity. d. There are ongong public health programs advocating planned-parenthood in all the states. e. There is a national Immigration Policy in place.
	2. Policy: to integrate concepts of conservation and sustainable use of biodiversity into all relevant sectoral polices, programs and plans.	a. To incorporate and develop the concepts of biodiversity conservation into all future National, State and Municipal social and economic policies and development strategies. b. To incorporate a population policy providing information pertaining to environmental and resource carrying capacities and poverty alleviation. c. Provide advice and technical information pertaining to the development of policies that fall within the NBSAP framework.	a. FSM included Environment as one of six priority sectors under Compact II with U.S.; the FSM Strategic Development Plan also includes an Environmental Matrix; the SDP is the guiding document for national and state development policies. b. No such policy currently exists. c. National government offices and departments – and relevant committees, councils and task forces – are working closely with TNC and MCT in country on an ongoing basis for this action.

	3. Multi-Sectoral Collaboration: to strengthen and develop multi-sectoral collaboration in promoting conservation, preservation, and sustainable use of biodiversity in the FSM.	a. Enhance and strengthen the linkages between National, State and Municipal government agencies, NGO's and private sector to provide information on the conservation and management of the FSM biodiversity (e.g. Pohnpei Resource Management Committee, Yap Environmental Stewardship Consortium and the Kosrae Resource Management Committee). b. Enhance the collaboration and assistance from regional and international agencies to assist the nation's stakeholders. c. Strengthen National and State linkages with regional and international environmental conventions that the FSM is party to. d. Develop and implement programs to further strengthen the partnerships between the private sector, NGO's and local community in implementing biodiversity related programs. e. Establish a multi-sector team of experts (domestic, regional and international) to conduct biological research, resource evaluations and monitoring programs on the FSM biodiversity.	a. Progress is being made on this action; national government has just recently granted $50,000 to NGO, Micronesia Conservation Trust (MCT); FSM Nat. Gov. and MCT collaborating on the EU CEPP through $800K grant. b. Donor revenue streams into FSM for conservation are quite strong, with national and state governments working with SPC, MCT, TNC, SPREP, and MSGP effectively. c. This action is being accomplished: e.g., Convention on Land Degradation and Desertification – Sustainable Land Management programs ongoing amongst each of the states, with facilitation by national government. d. NGOs and local communities are taking action collectively; a need for greater private sector involvement and buy-in. e. This is ongoing: e.g., recent REAs that were undertaken in all FSM states from 2005-2007; coral monitoring programs ongoing.
	4. Legislation: to ensure that appropriate National, State and Municipal legislation is developed and effectively enforced to sustainably manage the FSM's biodiversity.	a. Review and strengthen existing National, State and Municipal government environmental legislation and acts to incorporate relevant actions from the NBSAP and ensure integration of all themes across all relevant sectors within the nation. b. Review the FSM participation in international treaties relating to biodiversity to which the nation is a party. c. Support and further develop National, State and Municipal capabilities for the enforcement of all biodiversity legislation. d. Develop, implement and adopt EIA legislation at the National, State and Municipal governments to minimize the adverse impacts of the nation's development on the environment. e. Develop mechanisms and legal framework regulating access to traditional knowledge, intellectual property issues, genetic resources and bioprospecting. f. Develop ecological planning based on islands' biological carrying capacities.	a. This is a crucial action that still is not fulfilled. b. This action is being undertaken by national government, through Office of Environment and Emergency Management. c. Some workshops have been undertaken (funded by WildAid and facilitated by CSP); much more effort needs to be undertaken. d. Not yet done; a dire need to do so. e. No such mechanisms in place. f. This type of planning is not in existence in FSM as of this time.

Theme 11. Financial Resources

Strategy Goal	Objectives	Actions	Status of implementation
Local, regional and international financial sources provide for the long-term financial sustainability of all conservation and biodiversity related activities.	1. State Commitment: to define support needed to implement and monitor progress on the NBSAP at the State level.	a. Determine staffing and financial and other recourses needed to carry out NBSAP activities in the States. b. To define and establish incentives to implement NBSAP activities. c. Develop and support community based biodiversity-friendly NGO's.	a. This has been done; conservation NGOs largely fulfill much of the staffing needs through their program activities; government EPAs have at least one staff that is a focal point on NBSAP matters; FSM PAN Coordinator in place. b. Incentives well established: jobs and funding; MCT funds projects with ABS sites and EU CEPP funds projects that address Themes 1 and 8 in the NBSAP. c. This has been accomplished, but not so much through local governments, who often face NGOs as if they were competitors; support has come from international and regional organizations and foreign governments; FSM Dept. of R&D has also been very supportive.
	2. National Commitment: to provide, in accordance within national capabilities, long term national financial support and incentives for undertaking conservation programs.	a. Continue the development of long-term financial plans within each State for undertaking conservation programs at all levels of the government. b. Develop sustainable conservation funding mechanisms within the nation (e.g. allocation of tax revenue, user fees, eco-labeling). c. Continue National and State government budget allocations for staff and project activities for conservation and management of the nation's biodiversity. d. Develop and support community based biodiversity friendly NGO's. e. Design and develop a network of relevant biodiversity agencies for documenting revenues and expenditures on biodiversity related activities.	a. Long-term financial plan (sustainable financing mechanism) has been drafted and is in place; awaits government implementation. b. Although no such mechanisms are currently in place, feasibility studies on potential mechanisms have been undertaken and those that are considered feasible are being pursued. c. Budgets for actual conservation work within government have actually been reduced, or are non-existent under Compact II with U.S. d. Conservation NGOs in FSM are strong and supported well through various mechanisms. e. A network exists: Micronesians in Island Conservation.

	3. International Cooperation: to effectively acquire and allocate resources available under cooperation schemes with member of the international community.	a. To develop long term financial plans for undertaking sustainable biodiversity management and conservation programs for the nation. b. Continue developing linkages to regional and international donor organizations, including private foundations and NGO's to provide financial assistance for sustainable biodiversity management and conservation. c. Continue developing linkages with other developed country partners party to the Convention on Biodiversity (CBD) as a means to effectively implement and provide financial assistance for sustainable biodiversity management and conservation. d. Develop and regularly update a database of all potential donor assistance programs and distribute to all relevant agencies within the nation.	a. Long term financial planning has taken place through MCT and the Micronesia Challenge initiative; grants are already being provided. b. Donor revenue streams into FSM for conservation are quite strong, with national and state governments working with SPC, MSGP, MCT, TNC and foreign donors effectively. c. Linkages at highest levels of government are well-developed; an ongoing action. d. Action being undertaken at national government level; SBOC and EEM are the offices mainly responsible.
	4. Conservation Trust Fund: the continued establishment and development of the Micronesian Conservation Trust Fund (MCT) for implementation of the NBSAP and relevant biodiversity work.	a. Formally establish and implement the Micronesia Conservation Trust Fund (MCT). b. Identify long term funding sources for the establishment of this fund for the implementation of the NBSAP and relevant biodiversity related activities within the nation. c. Utilize the MCT to strengthen and empower resource owners and communities to manage their own resources sustainably. d. Explore the feasibility of establishing taxes and other sources of income generation for the use of the nation's biodiversity. e. Explore the possibilities of community based conservation trust funds.	a. Formally established in 2002 and fully implemented. b. An endowment has been launched for this purpose. c. MCT only funds projects that have strong community participation. d. Different options have been identified and are being explored for their applicability. e. This action has been explored, mainly by the conservation NGOs in the states; MCT will serve this role through agreement from all stakeholders, with sub-accounts for states/communities.

2.3 Mainstreaming of biodiversity in national programs

National Strategic Development Plan: 2004 -2023

Mainstreaming in principle of biodiversity considerations into national policies and programs has been made by the FSM through the transferrence of the NBSAP themes and actions into the Environment Sector Matrix (nine strategic goals) within the National Strategic Development Plan: 2004-2023 (Takesy 2009 pers. comm.). The environment, under the Amended Compact with the United States, is now categorized into a separate sector of funding, and therefore not seen as the cross-cutting issue it was under the original compact agreement between the FSM and the U.S. (Raynor 2004). The Mission Statement for the Environment Sector Planning Matrix in the SDP is comprehensive:

> *Recognizing the critical importance of the FSM's natural environment to the health and prosperity of this and future generations of Micronesians, the Environment Sector shall support the protection of the Nation's environment and achieve sustainable development of its natural resources. These efforts include the development, adoption and enforcement of policies, laws, and regulations in pursuit of the above-stated goals; the reduction and prevention of environmental degradation and all forms of pollution; adaptation to climate change; the protection of biological diversity, including assurance of adequate legal and international treaty safeguards relating to the protection of botanical and other agro-ecological property (including traditional knowledge and practices) belonging to the Federated States of Micronesia; the establishment and management of conservation areas; environmental infrastructure planning, design construction, and operation; interaction and cooperation with private sectors; and promotion of increased involvement of citizens and traditional leaders of the Federated States of Micronesia in the process of conserving their country's natural resources.*

Importantly, Strategic Goal number one in the Environment Sector Matrix is about mainstreaming:

> *Mainstream environmental considerations, including climate change, into national policy and planning as well as in all economic development activities*

Overall, the Environment Sector policy matrix includes the following policy elements (Raynor 2004):

- Encourage States to establish and support a system of conservation areas where special measures are taken to conserve biological diversity
- Create sustainable financing mechanisms for environmental and sustainable resource initiatives
- Expand and Promote Environmental Ethic
- Support the Development of Environmental NGOs and CBOs
- Create Strong Regulatory Climate when and where appropriate
- Improve cooperation and coordination between different levels of government
- Develop technical support for existing and future environmental programs

ADB Country Environmental Analysis

Additionally, in 2005, the Asian Development Bank and the FSM undertook a Country Environmental Analysis (CEA), a tool that the ADB assists member countries with in early incorporation of environmental considerations into the national country development strategy. The present CEA for the FSM focuses on the general environment status and trends in FSM, including the role of the environment and natural resources in the economy, the key environmental constraints and opportunities, the policy, legislative, institutional, and budgetary frameworks for environmental management, and principal constraints on, and barriers to, improved environmental management. It also identifies priority improvements in policy, institutional and legislative mechanisms, as well as programs and projects that will help to mainstream environmental concerns into economic development planning (Takesy et al. 2005).

2.4 Obstacles and challenges in the implementation of the convention

In 2002, the FSM National Biodiversity Strategy and Action Plan identified key cross-cutting issues which hamper achievement of good environmental performance throughout the nation. By and large, these same challenges ramain today (Hay and Takesy 2005):

- Rapidly increasing urban populations[89] and more consumptive lifestyles;
- Inadequate scientific baseline biological information on biodiversity status;
- Insufficient aquatic and terrestrial conservation areas and management plans;
- Insufficient biodiversity legislation and lack of enforcement;
- Insufficient skilled/trained human resources;
- Insufficient coastal planning and zoning;
- Inadequate awareness of links between conservation and sustainable economic development; and
- Insufficient funding for conservation activities.

A review of the implementation status of NBSAP actions reveals as much, with several key actions remaining to be achieved in small or large part. For example, without updated aerial photographs (Theme 1, Objective 1, Action 2), essential vegetation maps of the different ecosystems cannot be updated, and this in turn hinders accurate baseline data and ultimately, the establishment of conservation areas, as well as the potential for the restoration of degraded areas. The regulatory framework for conservation is also lagging throughout the country, and where it does exist to some extent, crucially, enforcement is often non-existent, or where enforcement is exercised, disincentives are minimal (Takesy and Hay 2005; GAO 2009).

[89] Today, for the first time in human history, more people live in cities than anywhere else in the world (AT&T 2010).

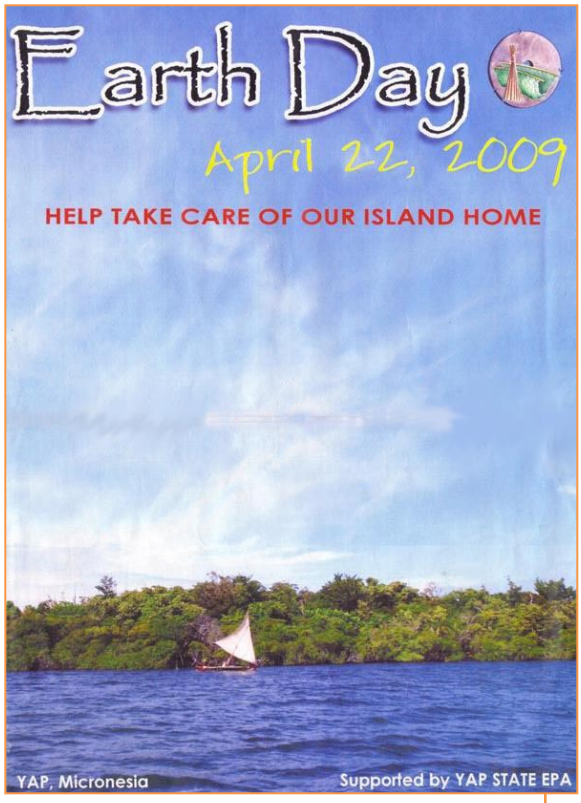
2.5 Analysis of effectiveness of the NBSAP in FSM

Nearly ten years in, it can be said that, though not all of the actions identified in the NBSAP have been carried out as envisioned, it has certainly proved an effective foundational tool to assist policy makers and the overall development process in the FSM. That is to say, where would the nation be ecologically without the NBSAP? The NBSAP has helped guide the commitments of the FSM as a signatory to the Convention on Biodiversity, one of the great international covenants between nations of the 20th Century. The NBSAP has also clearly allowed the FSM to set goals in working toward the goals and targets of the CBD, particularly the 2010 Biodiversity Target. Looking at the NBSAP in terms of how it has been effective on the ground, one can determine that it is the NBSAP that has guided the formulation and continuing support of the strong network of NGOs in the FSM in each of the main island centers (Theme 11, Objectives 1 and 2, Actions 3 and 6). This includes the evolution of the Micronesia Conservation Trust, which is in many ways the centerpiece of the ongoing NBSAP implementation. The NBSAP thus truly supports and guides the day-to-day missions of conservation-minded civil society in FSM. This is important and the effectiveness of the NBSAP in this regard cannot be underestimated for the FSM, where conservation NGOs are most often leading the way. As discussed above, the NBSAP has also been an effective tool for policy and decision makers in providing an ecological template for broader socio-economic policy document formulation, particularly the SDP in FSM, and a myriad of other short and medium term sectoral guiding documents, frameworks and legislations, e.g., the Infrastructure Development Plan, the EDF9 Conservation and Environment Protection Programme, the Kosrae Protected Areas Bill, and so on.

But assessing the effectiveness of the NBSAP - or assessing how well the NBSAP has been implemented – also reveals challenges and limitations. A thorough assessment of the NBSAP – as far reaching and ambitious as it is – reveals some serious limitations to the document itself. For example, has the environmental mindset, for the common people, and just as important, for policy makers and politicians, been expanded? Looking at the continuing decline of species and ecosystem biodiversity and health, and the continued expansion of industrial behavior and rapid growth, one would have to come to a negative determination. More importantly, have incentives to environmentally friendly business and economic practices, or conversely, disincentives to ecologically destructive development projects been established? Again, the NBSAP has not been effective in this regard. Are local financial resources being steered toward achievement of the strategic goals of the CBD? Again, and honest assessment would suggest a largely negative outcome. A large part of the NBSAP is committed to pollution and solid waste, yet human, animal and solid waste problems are ubiquitous and growing as the nation continues to urbanize and develop an all-encompassing western mindset. This is not to say that the NBSAP has failed. Far from it. An overall assessment reveals that by and large the NBSAP has benefitted the FSM greatly. Some of its aims will simply require patience and hard work. The goals of the NBSAP, the effectiveness of its implementation, can be completed with perseverence.

2.6 Domestic and international funding for priority activities

Domestic funding



Resource availability in the FSM is relatively clear cut as it relates to the implementation of the CBD and NBSAP. Domestic funding is largely through annual US Compact funds, which are funneled to the six sectors, with the Environment sector being the sixth and smallest at about $2 million available per year. Environment Sector funds have actually been closer to approximately $1.5 million per year in recent years[90]. Sector grant awards are largely given to government offices and departments for payment of operations and personnel on an on-going basis. US Department of Interior approved environment sector grants for FY2010 broke down across the federation this way:

Chuuk	$542,656
Kosrae	$271,354
Pohnpei	$404,195
Yap	$292,249
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Total	$1,510,454

These domestic funds have traditionally been allocated to the state EPAs, Departments of Agriculture, Marine Resources, Transportation and Resources & Development, the Tourism Bureaus, and YapCAP. Other domestic funds available come from fisheries licensing fees income to the nation, and are sometime allocated as appropriations from the respective state congressional delegations to NGOs and community groups for environmental projects.

International funding

International funding mostly goes to the NGOs of the nation. Indeed, the NGOs are a vital asset to the nation on two levels: they not only are the principal implementers of the NBSAP, they also bring in millions of dollars of overseas development revenue to the country, which is a growing component of the overall job base and economy. The primary sources of funding are from US Federal grants (these are considered a

[90] Total FY2010 Compact sector grant allocations were for Education - $28,171,015; Health - $21,007,869; Public Sector Capacity Building - $2,887,816; Environment - $1,579,510; Private Sector Development - $2,333,638; and Infrastructure - $24,303,552.

different category of funding than Compact funds) such as USAID, USDA, USDA, USFS, NOAA and the USDOI[91], amongst several others. The NGOs also finance NBSAP activities – establishing conservation areas, community partnership building and consultations, environmental awareness campaigns, trainings and workshops, etc. – through the GEF-supported Micronesia Small Grants Programme, the Micronesia Conservation Trust, from foreign governments such as Japan, the European Union, Germany, Italy, Australia, New Zealand, and other private foundations and donors. International funding to the FSM for FY2007 in the environment sector:

National	$1,266,585
Chuuk	$491,560
Kosrae	$148,276
Pohnpei	$372,500
Yap	$385,500
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Total	$3,046,712[92]

Funding streams from these donors are consistent on a year-to-year basis, but they are certainly not gauranteed, nor do the donors allocate funds toward the environment specifically every year. As such, resource availability for implementation of the NBSAP should still be considered inadequate. The Micronesia Conservation Trust will assist with consistency of funding over the long run through a $20 million endowment that has been recently launched. MCT also provided nearly $3 million for conservation from 2007 – 2009. Still, the FSM collectively needs much more financial resources allocated to the cause of biodiversity maintenance – both for government and the NGO and private sector. Due to the important role that the NGOs play in this arena, they especially require greater longer-term financial support.

2.7 Way forward

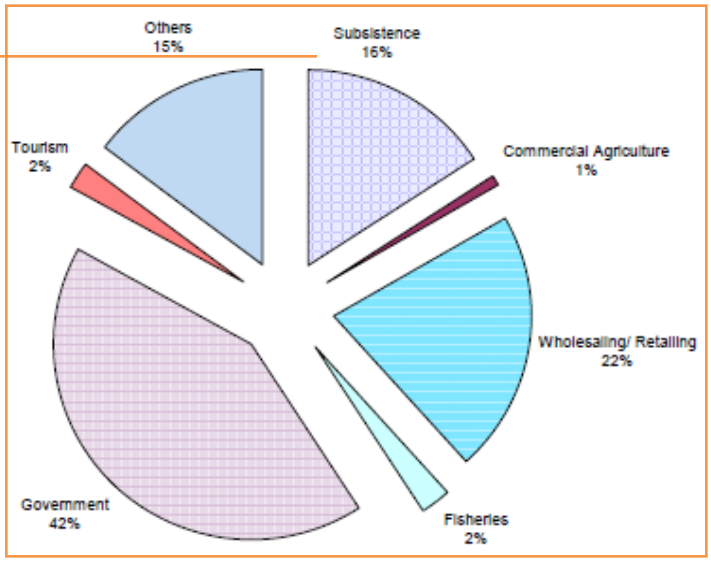
Sound environmental management is a profitable investment, not an unproductive cost (Takesy et al. 2005). This is a statement that really lies at the heart of the intersection between economic expansion and environmental integrity. As dollars influence the people of the Micronesian region in greater depth, choices must be made. One area of the FSM NBSAP – and an essential focal area of the CBD – brings this to light.

[91] As part of the Compact agreement with the U.S., the FSM is eligible for more than 1,000 U.S. federal grant programs, of which it currently accesses just over 50. US Federal grants are not counted as domestic revenue, but international in scope, as official overseas development assistance.

[92] This is based on government statistics; it was also reported that these figures represent monetary amounts that were granted through the national government and therefore may also include allocations to the government sector and not just NGOs; furthermore, due to issues of trust from many of the conservation NGOs, these figures are likely low as budgets and sources of funding from the respective conservation NGOs were not able to be obtained by the government.

Theme 1, Objective 3, Action 3 of the FSM NBSAP discusses the valuation of ecosystem services. How does a society that begins to value cash over everything else decide what the value of a clear stream is, an intact swamp forest, an untouched watershed, an unpolluted estuary, a thriving, unsilted reef? In the FSM these are immensely valuable, but is there a conscious movement at all levels, especially at the state, national and international decision-making levels, to recognize this? For the FSM, there is no clear answer.

The NBSAP is only one component, a tool in the biodiversity tool-box to ensure that the quality of life remains unique, thriving and healthy. And as biodiversity goes, so to do the people's natural lifestyle: a study conducted over a three month period in 2005 revealed a great diversity of local food items (381 different species) consumed by a small, rural community in the FSM (see **Table 11** in **Chapter 1** of this report - *Summary of the Mand community traditional food list*). People in this nation still rely heavily on the environment for sustenance. Implementing the convention can help ensure this continues. Maintaining the habitats and ecosystems that nurture biodiversity is vital for maintaining the quality of life of the people and sustaining the country's rich traditions. Subsistence production officially comprises 16% of total GDP for the FSM, but it is likely much closer to 30% (Takesy and Hay 2005). Out of some 29,000 employed persons in 2000, 15,000 persons (52%) were engaged in farming and fishing, of whom over 10,000 (70%) were involved in 'subsistence' (household consumption only) activities, not selling or intending to sell any of their produce. Almost 5,000 (30%) were classified as 'market-oriented' farmers and fishermen. These numbers illustrate the importance of the subsistence sector in the FSM and the need to include subsistence workers in the labor force definition to reflect their contribution to domestic production in the country (Takesy and Hay 2005), and thereby move closer to a conscious realization of the value of ecosystem services. Let's begin with these numbers: in-country agricultural activities provide over 60% of the food consumed, and employ almost 50% of the labor force on a full-time or seasonal basis. While FSM's climate is well suited for year-round subsistence agriculture, farmland is in short supply because of the mountainous, heavily forested terrain on FSM's larger islands, but water and sun are both plentiful. The ocean is even more valuable to the people, arguably the country's most significant cultural and ecological resource. FSM's EEZ covers the world's major equatorial tuna migratory paths. The approximate market value of tuna harvested within the nation is conservatively estimated at $200 million per year. FSM has in recent years earned $18-24 million annually in licensing fees paid by foreign vessels for tuna fishing within its EEZ (Takesy and Hay 2005). Average annual catch rates range between 80,000 - 250,000 metric tonnes. And then there are the reefs, where hundreds of species of edible fish are harbored and produced by the



Source: Asian Development Bank, 2005

mangrove forests and seagrass meadows each year. These inshore reef resources are largely consumed locally and are an essential source of nutrition in the traditional Micronesian diet, providing at least 38% of the protein consumed by adults (Englberger et al. 2006). All waters located within 22.2 km of land falls under the jurisdiction of the respective state governments. Estimates of actual harvest are nearly impossible to guage and vary widely, with up to 10,000 metric tonnes ($24 million) of coastal fish harvested annually by commercial and subsistence fishers. In 2002 reef fish, crabs, lobster and live clams valued at over $330,000 were exported, according to official statistics (Takesy and Hay 2005). These are massive numbers, important numbers. Within these we begin to see the value of ecosystem services to the sustained health and livliehood of the people of the FSM. Without these numbers, other numbers will surely increase: rates of poverty and destitution being the first (Nimea 2006; Abbott 2008).

And yet assessments indicate that fish populations in reefs close to the larger, more urbanized areas are severely depleted. In some areas, reef destruction from over fishing, dynamiting and dredging is extensive (Takesy and Hay 2005).

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[93] 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. With a country encompassing an estimated 14,517 km2 of coral reefs (Rohmann et al., 2005), and holding some of the most rarified tropical rainforests on earth, additional funds for conservation efforts, including on-the-ground monitoring and aeriel photography, are critically needed (for a good justification, see **Table 2** in **Chapter 1**). 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 (NOAA 2008). The FSM is certainly at a crossroads in its history. It also has the will to succeed where other nations have not. Much work and effort remain to be done if the strategic goals of the NBSAP and the SDP are to be met.

[93] Theme 11 of the NBSAP (Objective 1, Action 3) has been a relative success, with a national network of active consrervation NGOs operating in each state of the federation, including KCSO, CSP, CCS, YINS, YapCAP and others.

Fourth Country Report from the Federated States of Micronesia
to the United Nations Convention on Biological Diversity

Chapter III

Sectoral & Cross-Sectoral Integration of Biodiversity Considerations

"It is up to us to determine out future. We have set the vision for what we want…You cannot just develop and not factor in environmental considerations…We can develop today and get wiped out tomorrow.**"**

---From an Article Entilted, "3rd Economic Summit: FSM Wants High Growth", a quote from Joe Konno, Micronesia Conservation Trust Board Member, presenting the national environment sector strategy to the Plenary at the FSM 3rd Economic Summit, March 2004.
(Source: Serehd Magazine, April 2004, Vol. 6, No. 2)

"In its initial development context, sustainability was used primarily in the realm of economics: whether a particular economic approach would be sustainable for a society…While some level of economic growth may be needed in many Pacific island countries, there is no model of growth which is sustainable over time. We live on a finite planet, and the limits of our growth are rapidly being reached, if not already exceeded in some domains…looking at sustainability in strictly economic terms misses the larger point: failure to pay attention to the long-term viability of the society's natural resources (land, air, water at a minimum) means there can be no real sustainability in the long run."

--- From an Essay Entilted, "Self-Sufficiency and Sustainability", by Dr. Maradel K. Gale, Director of the Micronesia and South Pacific Program and Associate Professor in the Department of Planning, Public Policy and Management, University of Oregon

Chapter 3

3.1 Introduction

In this chapter, we will be reviewing ongoing FSM efforts to integrate biodiversity conservation and sustainable use into relevant sectoral and cross-sectoral plans, programmes and policies as required by Article 6 (b) of the Convention. This is what is otherwise referred to as mainstreaming. Clearly, achieving the objectives of the Convention, and in particular the 2010 target and goals and objectives of the Strategic Plan, will be impossible without engaging the main sectors and key actors that have impacts on the conservation and sustainable use of biodiversity. As such, we will here attempt to identify as best as possible the processes by which biodiversity has been integrated into these sectoral and cross-sectoral strategies and plans and relevant measures taken by various levels of government and other stakeholders.

It should be noted at the outset that while the FSM has made conscious strides in this regard, there is much work yet to be accomplished due to a number of factors, the greatest of which is likely the fact that prior to 1999, environment was considered a crosscutting sector by the FSM National and State governments, and was dealt with as such. However, the planners of the 1999 FSM Economic Summit agreed to consider environment as a stand-alone sector. During the Summit, about thirty representatives of State and National government, as well as several NGOs and community representatives, developed an Environment Sector policy matrix that included the following policy elements:

- Encourage States to establish and support a system of conservation areas where special measures are taken to conserve biological diversity
- Create sustainable financing mechanisms for environmental and sustainable resource initiatives
- Expand and promote the Environmental Ethic
- Support the development of environmental NGOs and CBOs
- Create strong regulatory climate when and where appropriate
- Improve cooperation and coordination between different levels of government
- Develop technical support for existing and future environmental programs

The Environment Sector was further recognized and supported when the FSM Joint Compact Negotiating Committee and the US Government agreed to establish environment as one of the six focal sectors under the amended Compact of Free Association in 2000. A tentative budget of $2 million/year was agreed on in principle, which has since then been made more flexible (Raynor 2003). So although it was an excellent decision to recognize the environment as an issue important enough within the overall development context of the nation to be prioritized as one of the six priority sectors for annual Compact II funding, it has also had the

effect of compartmentalizing the environment into a category and therefore often lessened the focus on the need for full cross-sectoral and cross-policy consideration.

This chapter will also bring up the discussion of what is known as the ecosystem approach, which is the central theme of the CBD and the underlying factor in the principle of mainstreaming. The ecosystem approach is simply valuating the environment into all development decisions the same as one would valuate economic or social outcomes in development prerogatives[94]. This will lead to a final summary analysis of Convention outcomes achieved through effective implementation of this approach.

Furthermore, this chapter will also elaborate briefly on whether biodiversity has been included in FSM environmental and strategic impacts assessments, which is a crucial step to ensure that policies, laws, programmes and projects that may have adverse impacts on biodiversity will be amended or prevented. The collective municipal, state and national policy framework – and effective implementation – surrounding protection of biodiversity and natural resources is imperative; it is an attempt to regulate the desire for immediate gain for long term stability, in the social, economic and environmental realms.

Finally, this chapter will also address other national and sub-national strategies, programs, plans and to the degree relevant, assessments that point toward policy through solid recommendations. These will include issues related to poverty reduction, national plans for achieving Millennium Development Goals, the national Strategic Development Plan, national action plans to combat desertification, land degradation, climate change, energy issues, waste management and other such strategies.

3.2 Integration of biodiversity into sectoral strategies and plans

The National Strategic Development Plan (2004-2023) (SDP) is the document which guides all ensuing sectoral strategies and plans in the FSM. This section will thus be organized around the major focal areas of the SDP, which are agriculture, fisheries, tourism, environment, health, education and gender (SDP 2003). These focal areas are integrated into the six priority sectors for funding over the 20-year period of the amended Compact between the FSM and the U.S., and they are private sector development, public sector capacity building, education, health, environment and infrastructure. The questions that should thus be answered here are, do these primary, underpinning sectors that guide the development of the FSM over the long term have any specific action plans, and more importantly, if so, do they integrate biodiversity considerations into their overall implementation? Those sectors where the answer to both is in the affirmative are reviewed below.

[94] In Yap this is referred to as the Third Nguchol, or third pillar, a central theme in the YBSAP.

The NBSAP themes – and thus the priorities of the convention – are contained with the SDP, in the Environment strategic planning matrix. The environmental strategy contained within the SDP, as implemented by the various institutions within the country, seeks to mainstream biodiversity considerations through a myriad of broad individual[95], systemic and institutional means. The primary implementation and monitoring body established at the national government is the President's Environmental Management and Sustainable Development Council (SD Council). The SD council is an interdepartmental, intraagency advisory board chaired by the Vice President of the nation. The SD Council includes representatives from the public and private sectors, non-governmental organisations and other interest groups, including state-designated counterpart departments to take on the responsibilities of coordinating many of the SDP and NBSAP activities for their respective state-level action plans.

Each of the sectors has principal units, offices or departments at the national government level that coordinate the relevant activities with the state government counterparts, and to a lesser degree, with NGOs. This process is followed for each of the sectors under the amended Compact. As a generalization, most sectors do as a matter of course attempt to ensure that ecological function and conservation measures are integrated into annual project plans and programs, however, a better integration of biodiversity considerations is still required across the range of relevant development sectors in the FSM.

The FSM does have several policies and plans in place that are relevant to the discussion here. How they integrate environmental considerations will be discussed more fully in each applicable section below. Perhaps most significant is the FSM Infrastructure Development Plan (IDP), the document that lays out the state and national priorities for all major infrastructure development through 2023. The IDP has profound implications for biodiversity considerations in the nation over the long term, and how well the IDP incorporates these considerations in implementation will largely determine the overall achievement of the convention goals. The FSM is also in the process of developing its draft National Millenium Development Goals report, integrating and localizing the eight MDG goals into national and state sector plans and strategies, including MDG Goals 1 and 7, poverty reduction and environment, respectively. The FSM has also recently completed a draft Climate Change Policy (January 2010) and it has been submitted to all executive branch departments and offices to integrate the provisions of the policy into each of the sectors so that climate change is addressed in a mainstreamed fashion. These sectoral action plans will be under the purview of four offices: Office of Environment and Emergency Management (OEEM), Department of Resources and Development ((R&D), Department of Transportation, Communication and Infrastructure (TC&I), and the National Oceanic Resource Management Agency (NORMA).

As for the same principle of sectoral planning and responsibility for the goals of the Convention (NBSAP) throughout the planning and implementation of programs, this is something that is ongoing in the FSM, with each administrative unit working toward integrating the objectives of the conservation and sustainable use of

[95] As an example, Strategic Goal 8 for the national environment strategy, to *create sustainable financing mechanisms for environmental and sustainable resource initiatives*, has as an outcome to develop "at least 10 new FSM conservation/environment leaders by 2010", through various educational, peer learning, and other training activities (SDP 2003).

biodiversity as key programming principles. OEEM and R&D are principally responsible for this on a day to day basis at the national government. Significantly, implementation of the NBSAP throughout the FSM is spearheaded by the state NGOs, with national guidance and oversight increasingly being assumed by the Micronesia Conservation Trust (MCT) (see **Chapter 2**). Established as a financing mechanism for conservation initiatives and long-term achievement of the Convention goals and the 2010 Target, MCT has been a major policy element accomplishment (Raynor 2003) for the nation.

Taking into account some of the weaknesses and obstacles to effectively achieving the mainstreaming of the environmental ethic in all socio-economic considerations of development, the FSM has developed a National Assessment Report toward formulation of an integrated National Sustainable Development Strategy that partially relies upon the ecosystem approach (Nimea 2006). This strategy calls for an improvement in the current set up of the SD Council, giving it an expanded role, with sanction power beyond its current advisory capacity mandated from top leadership in government, private sector and civil society in order to have greater effect and force. This will have the effect of creating more meaningful cross-collaboration and ultimately better sectoral integration of economic, social and environmental plans. The strategy also notes some central issues to effective achievement of the convention goals within the country, chief amongst them is that the "NBSAP was prepared primarily by environmentalists and hence failed to significantly influence economic planning" in a manner that would allow for better integration and sustainability of the mainstreaming effort. Current effort also suggests that the FSM, in order to achieve better socio-eco – enviro integration, that sustainability and environmental concerns should be better linked with socioeconomic priorities and that greater attention to poverty issues must be realized. As such, the FSM has concluded that "the principles of sustainable development in FSM are largely accepted by environmentalists, certain high level government officials, and academics, and are

Micronesia Conservation Trust

Beginning in February 2001, in response to a recommendation from the 1999 Economic Summit, a group of 18 private and public sector leaders from the four FSM states - collectively representing the national government, state and municipal government agencies and legislatures, private businesses, local NGOs, and traditional leaders - formed a steering committee to create the MCT as a sustainable source of funding for activities to realize the goals of the country's environment strategy. The steering committee met with representatives of two other trust funds in the region—the Foundation for the Philippine Environment, and the Papua New Guinea Mama Graun Conservation Trust Fund. In board meetings in May 2002, a 3-year strategic and financial plan and a comprehensive fundraising plan were completed and approved. The Micronesia Conservation Trust is set up as a private non-profit corporation with a governing board that include members from national, state, and municipal governments, NGOs, business, and academic institutions. It is working to mobilize funding from a variety of sources to build an endowment from which to provide long-term support for sustainable natural resource management throughout Micronesia. The Trust places special emphasis on building the capacity of Micronesian organizations to design and manage conservation programs. In addition, the MCT provides a forum to bring together the national, state, and local governments with private enterprises and non-government organizations to collectively address the challenges of natural resource management, form public-private partnerships, and share experiences and best practices. MCT is the first such institution in the region.

(Raynor, 2003)

yet to make their way into mainstream economic planning." It further appears that in FSM there is a stronger consensus, including broader public and government support and commitment, around general issues and principles of development than to its specific details, especially one that embraces the integration of economic prosperity and higher levels of social welfare with preserved environment. Based upon key recommendations made, the FSM government and the key institutions involved in sustainable strategy development are now focusing on improving the policy and legal environment for strategic sustainable development planning, and strengthening the government capacity to better manage the process, including the improvement of planning and implementation.

These actions include: (i) establishment of a commitment to the principles of a sustainable society in constitutional or other fundamental statements of national policy; (ii) revamping the SD Council and integrate National Sustainable Development Strategies into its core business as well as expanding its power and composition; (iii) establish a comprehensive system of environmental law and provide for its implementation and enforcement; (iv) review the adequacy of legal and administrative controls, and of implementation and enforcement mechanisms, recognizing the legitimacy of local approaches; (v) ensure that government policies, development plans, budgets and decisions on investments take full account of their effects on sustainable development; (vi) strengthen the knowledge base, and make information on social, economic, and environmental matters more accessible; (vii) improve exchange of information, skills, and technologies by creating local, state, national, regional and global alliances; (viii) strengthen policy formulation to make them more coherent and to create the right conditions to promote sustainable development; (ix) communicating and mobilizing citizens and business (civil society and the private sector play important roles in sustainable development. Initiatives need to be taken to encourage active involvement of these groups, and to improve the consultation processes and the mobilization of stakeholders); and (x) good governance that creates an environment that is conducive to sustainable development and to the elimination of poverty.

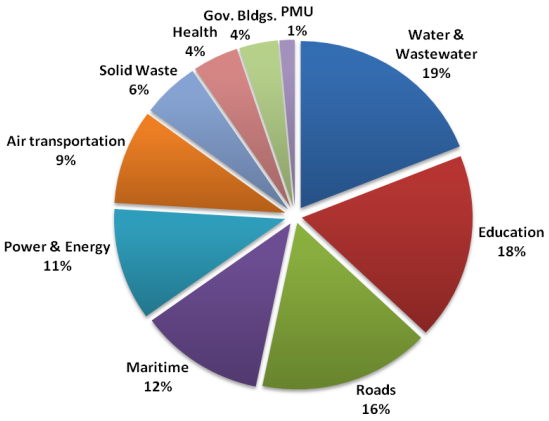
3.2.1 Infrastructure

The Infrastructure Development Plan (IDP) has profound implications for biodiversity considerations in the nation over the long term, and how well the IDP incorporates these considerations in implementation will largely determine the overall achievement of the convention goals. There are two fundamental ways in which the IDP will either assist natural ecosystem function in the federation, or conversely, act as a multiplier of anthropogenic threats to the nations' biodiversity, particularly as it relates to displacement or conversely, rehabilitation. Foremost, the IDP is the major component of annual funding to the FSM through the Compact with the United States, and therefore adds significantly to short and medium term economic growth. Additionally, if implemented properly, this far-reaching sectoral plan will also be a significant solution to many of the current urban and rural pollution problems discussed as one of the primary threats to biodiversity discussed in **Chapter 1**. For

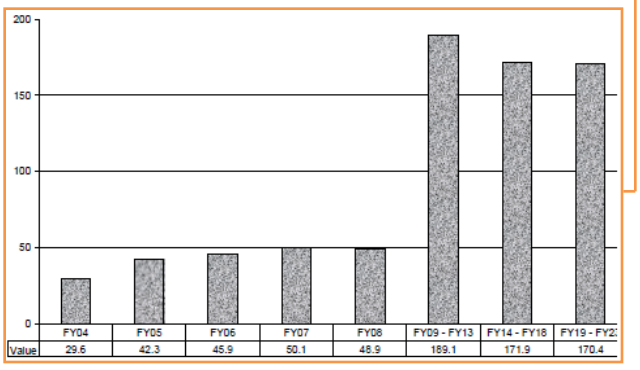
example, Water Supply/Wastewater and Solid Waste Management are two of the long term planned investments (**Table 15**) for the FSM under the auspices of the IDP. Currently, wastewater and sewage are emblematic features of degraded terrestrial and marine environments around the more populated centers of the FSM. The IDP therefore is an excellent tool to address these issues, and effective implementation of the IDP for these components is a necessity: currently the IDP requires that all infrastructure projects conduct EIA's to minimize run-off and other impacts and that all physical planning incorporate environmental considerations (Westerfield *pers. comm.* 2009).

TABLE 15: Infrastructure planned investments through 2023 for FSM

Sector	Amount ($ millions)
Water supply/wastewater	141.9
Education	135.4
Roads/pedestrian facilities	120.9
Maritime transportation	88.5
Electric power	81.1
Air transportation	68.4
Solid waste management	40.8
Health	32.5
Government buildings	27.3
Program management	10.7
Total:	**747.5**



Conversely, without proper regulatory environmental oversight, the IDP – simply due to the sheer magnitude of its scope for such small land masses – may also be the cause of further degradation of ecosystems and displacement of species. Roads, airports and government buildings all require massive resource inputs and the displacement – often - of forests and reefs. Effective environmental impact assessments and the application of best alternatives that integrate the valuation of ecosystem services into these projects will help to ensure ecological integrity while providing progressively better services to the populace. Infrastructure projects that have been identified over the initial years of the amended Compact are intended to take into account national interest criteria such as impact on the economy, health and safety of the community, contribution towards development of the FSM workforce, potential for private sector development, viability, sustainability, potential social benefit and *environmental impact and risk exposure* (SDP 2003).



Source: FSM SDP, 2003

3.2.2 Fisheries

As stated, fisheries, and their appropriate use and conservation, are the greatest resource the FSM has in terms of fulfilling the socio-economic aspirations of the populace. Indeed, the FSM's long-term prospects for economic self-sufficiency rely on three sectors highly dependent on the continued vitality of the natural environment: fishing, agriculture, and tourism (Nimea 2006). Before noting some of the key strategies, policies and plans related to fisheries conservation in FSM, let's first briefly elaborate on the ideas exposed in **Chapter 1** (Section 1.5.3, page 82) on the critical ecological value of continued viability of offshore, coastal and subsistence fisheries to the island communities of the nation (**Table 16**). Tuna in particular are nearly literally the foundation for communal and national livelihood. Recent estimates for per capita annual fish consumption highlight this, with the numbers ranging from 72 to 119 kg per person per year (SPC 2002). Taking the average, it can be assumed that annual per capita consumption is 96 kg, with FSM then having consumed about 10,900 mt of fish. If the population expands 1.85 times between 1999 and 2025[96], and per capita fish consumption remains the same, about 20,250 mt of fish will be required in 2025. This underscores the value of the ecosystem services that the coastal and marine environments provide.

TABLE 16: Landings for coastal, offshore and subsistence fisheries in FSM (tonnes)[97]

Island of port	Offshore locally-based	Coastal commercial	Subsistence	Total
Kolonia, Pohnpei	2,000	1,700	650	**4,350**
Weno, Chuuk	250	2,000	500	**2,750**
Colonia, Yap	200	800	500	**1,500**
Lelu, Kosrae	50	200	250	**500**
Other	0	300	3,100	**3,400**
Total:	**2,500**	**5,000**	**5,000**	**12,500**

Source: SPC, 2002

More specifically, looking at the economic contribution of these ecosystem services, estimated coastal fisheries production and value is approximately 6,243 metric tons (mt) valued at $11,237,400 for subsistence fisheries and 637 mt valued at $1,483,544 for small scale commercial fisheries (ADB 2005).

[96] As approximated through variables on migration and changes in fertility, the 2025 population – according to an estimation made by SPC in the late 90's – is likely to be between 184,800 and 236,900. Taking the midpoint, this would be 1.85 times the 1998 population.

[97] In addition to the above, 127,000 tonnes of fish was caught in 1999 by foreign-based offshore vessels. This catch was not landed in FSM, but (a) for purse seine fish, at the canneries in American Samoa or transshipped to other processing facilities in Asia, or (b) for longline fish, in Guam or Japan, or (c) for pole/line fish, in Japan (SPC 2002).

The FSM Statistics Division has suggested that some 490 mt of fish and shellfish worth about $1.2 million was "purchased by local fishing markets" in 1997. The Household Income and Expenditure Survey reported that $18,496,000 was spent by FSM households on fresh and frozen fish, the vast majority of which come from small-scale commercial fishing. Using average fish price information (1999), this equates to 6,323 mt of purchased fish. Extensive fieldwork conducted in this regard in Pohnpei estimated the total coastal fishery production of Pohnpei Island to be about 1,780 mt (75% reef/inshore, 25% pelagic). Of this, 780 mt was attributed to subsistence catch and 1,000 mt to commercial effort (with the proviso that approximately 28% of this was for non-sale domestic consumption). If the catch level reported in Pohnpei (32% of FSM population) was extrapolated to all of FSM, the coastal fisheries catch would be about 5,500 metric tons. However, taking into account population increase and the likely higher per capita catches of the outer islands and Chuuk, a more likely catch estimate is approximately 8,000 metric tons per year (ADB 2005). With known increases in fishing effort in recent years and increasing populations, an approximate indication of coastal fisheries production would possibly be in the range of 10,000 mt. At $2.90 per kg for the commercial catch and $2 per kg of value for the subsistence catch this equates to a conservative value of $24.5 million per year (ADB 2005).

As such, most of the management objectives and strategies are related to the protection of the resource base so as to assure continuity of food supplies, or viability of commercial exploitation. In some locations, protecting species from extinction (e.g. turtles) is an objective (SPC 2002). Other near-shore fisheries strategies include reef tenure with selective exclusion of outsiders (Yap and some Chuuk locations) and regulation of coastal commercial fisheries by conventional centrally-administered regulations (Pohnpei and Kosrae). There has also been a conserted national effort toward the use of community-driven marine protected areas as a strategy for coastal fisheries management (SPC 2002). This is led by the PAN and PIMPAC initiatives spearheaded by the FSM Department of R&D, and MCT, respectively (see **Chapter 2**).

Probably the most comprehensive nation-wide initiative on the subject of inshore fisheries management was at the FSM Coastal Fisheries Consortium held in Pohnpei in December 2000 (SPC 2002), which brought together the primary actors with management policy oversight of the nation's fisheries: the Department of Economic Affairs (now the Department of Resources and Development) Fisheries Division, the Micronesia Fisheries Authority (now the National Oceanic Resource Management Authority) and the National Fisheries Corporation. This consortium recommended and helped to initiate a College of Micronesia AS-level degree training program in fisheries management; an addition to Element 3 of the Inshore Fisheries Policy Matrix to discourage commercial exploitation; a system to monitor and analyze overall fisheries production; and, to incorporate marine environmental stewardship into primary and secondary curriculums for expanded public awareness of marine management (FSM 2000).

The FSM also has an existing Tuna Management Plan[98]. The objectives are arranged in two different levels: (1) overall long-term objectives, and (2) specific objectives. The three overall objectives for tuna fisheries management are to ensure that the nation's tuna resources are used in a sustainable way; to obtain maximum,

[98] It was formulated during 2000 by the MFA (NORMA) with technical assistance from the Asian Development Bank.

sustainable economic benefits from the nation's tuna resources; and, to promote economic security for the nation through the use of tuna resources. The specific objectives are to ensure that the tuna catch does not exceed sustainable levels; obtain national revenue from foreign fishing access agreements; support development of FSM-owned and/or foreign FSM-based fishing enterprises; encourage investment in enterprises related to tuna fisheries; promote employment opportunities; and, enhance international relationships beneficial to FSM (SPC 2002). NORMA implements the provisions of the plan with Congressional oversight, as per its mandates contained in Title 24 of the FSM Code[99]. The species covered by the plan are Skipjack (*Katsuwonus pelamis*), Yellowfin tuna (*Thunnus albacares*), Bigeye tuna (*Thunnus obesus*), and Albacore tuna (*Thunnus alalunga*) (SPC 2002). The four tuna species are also covered under several regional management agreements as well as the international agreement, the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, of which FSM is a signatory. The regional management agreements are:

- Harmonized Minimum Terms and Conditions for Foreign Fishing Vessel Access;
- Wellington Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific;
- Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific;
- Nauru Agreement Concerning Cooperation in the Management of Fisheries of Common Concern;
- Palau Arrangement for the Management of the Western Pacific Purse Seine Fishery; and
- FSM Arrangement for Regional Fisheries Access (ADB 2005).

photo by O.L. Wartel

The FSM Fisheries strategic planning matrix contained within the SDP (Volume II, Appendix B-03, pg. 39) contains five integrated strategic goals for the fisheries sector designed to "ensure maximum economic benefit", are "managed with best practice methodology", "meet subsistence and artisanal needs" and "sustain biodiversity and resource abundance." In addition, the FSM also hosts the international body that oversees the membership and provisions of the Convention, the Western and Central Pacific Fisheries Commission (WCPFC), commonly referred to as the Tuna Commission. As the FSM contains the central geographic position within the region where the last great tuna stocks are[100], it thus makes sense for it to house such an institution as well. The members of the Tuna Commission include Australia, China, Canada, Cook Islands, European Union, Federated States of Micronesia, Fiji, France, Japan, Kiribati, Korea, Republic of Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Philippines, Samoa, Solomon Islands, Chinese Taipei, Tonga, Tuvalu, United States of America, and Vanuatu. Participating territories include American Samoa, Commonwealth of the Northern Mariana Islands, French Polynesia, Guam, New Caledonia, Tokelau, and Wallis and Futuna.

[99] NORMA has a broad range of mandates that include concluding fishing agreements, establishing fishing fees, issuing permits, determining allowable levels of fishing, and other important functions.

[100] According to the Secretariat of the Pacific Community's Oceanic Fisheries Programme (SPC-OFP) 2009 annual report on the status of tuna and swordfish stocks in the Western and Central Pacific region provided to the 70th meeting of the Pacific Islands Forum Fisheries Committee Officials Meeting held in Alofi, Niue, "despite the continued increase in the catch of skipjack tuna, this highly productive resource is considered by the scientists to be in a healthy state. However, there are significant concerns over the status of bigeye tuna and yellowfin tuna and mounting evidence of overfishing. Overfishing of these species is a serious concern for the Pacific, as they are important for locally-based fisheries and yellowfin in particular is an important food resource for many coastal communities" (FFA 2009).

Cooperating Non-members include the countries of Belize, Indonesia, Senegal, Mexico, El Salvador, Equador, and Vietnam (WCPFC 2009). Greenpeace often acts in an advisory and unofficial observer capacity to the annual Commission regular session meetings[101].

The Convention on Fish Stocks, as well as the WCPFC has made progress, with several notable highlights, including the establishment of a proactive fishing Observer Program aimed at 100% coverage of all purse seine fishing vessels in order to monitor and report on all fishing actions of licensed vessels; adopted a measure on what are referred to as non-target species, specifically to identify five key shark species of thresher shark, oceanic whitetip shark, make shark and blue shark, and strengthen data collection and research on the current situation of sharks[102]; and finally, a crucial and much-lauded achievement: the high seas pocket closures, where fishing vessels will no longer be allowed to fish in high seas pockets adjacent to the Exclusive Economic Zones (EEZs) as a condition of their licenses, with closure of two high seas pockets adopted in December 2008, and the closure of additional high seas pocket areas between latitudes of 20 degrees North and 20 degrees South a year later in December 2009.

3.2.3 Forestry

FSM currently has no nation-wide forest policy as such, however there are several initiatives, policies and programs in place that seek to continue to strengthen the safegaurding of the nation's most valuable forests, from watersheds to mangroves. The fact that there is no overarching national policy in this regard is likely due to the strictly adhered to proviso that the forests within each of the states – particularly the high islands – fall under the control and jurisdiction of the state governments, not the national government. The four states of the FSM have strong autonomous rights over their land and near-shore resources, and the forests are certainly no exception. Yet, there are several well-coordinated initiatives facilitated by the national government. One of note eminates out of the FSM's assension to the UN Convention to Combat Desertification and Land Degradation (UNCCD), whereby each of the states is currently implementing various Sustainable Land Management (SLM) initiatives through the local resource departments and conservation NGO's. This program is

[101] Greenpeace, in a May 2009 press release, said the outcome of recent WCPFC meetings is a failed compromise – one which is too weak to stop the overfishing of the Pacific bigeye and yellowfin tuna -- one with a range of measures including only a 10 percent reduction in longline catch, where leading experts have called for an immediate 50% reduction in order to avoid potential irrevocable decline. Greenpeace also noted that the fishing industry resisted moves to ensure the long-term sustainability of the fishery, despite strong economic reasons to do so. Recent studies indicate the fishing industry is undermining its own profits by having too many fishing vessels on the water and by depleting stocks to the point fish are harder to catch (FFA 2009). "A handful of fishing nations are sending entire species into oblivion. Consensus-based decision-making in the tuna commission ensured that many decisions here were diluted to the lowest common denominator of agreement," said Lagi Toribau, Greenpeace Australia Pacific Oceans Campaigner. "Short-term interests ruled. And the needs of the Pacific Island States, whose livelihoods and economies depend on tuna, have been relegated to a minority voice." Toribau added that, "Overfishing in the Pacific has worsened to a state that several fishing industry representatives in the meeting actually called fishing nations to follow the advice of scientists and reduce fishing. The political process is still unwilling to follow the science."

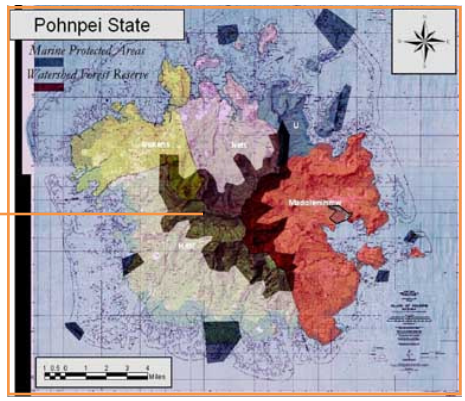
[102] Shark populations are becoming increasingly threatened throughout the tropical Pacific due to the unrestrained South-east Asian-based shark fin fishery. Special consideration should be given to protecting local reef shark populations (including Black-tip, White-tip, Grey Reef, and Silvertip sharks) because of the critical role they play in the marine ecosystem. The global shark fin trade kills approximately 100,000 million sharks per year. Intense fishing over a relatively short period can cause considerable harm due to the territoriality of reef sharks, their slow growth rate, and low birth rates. Low populations of sharks have significant negative impacts to the coral reef community and throws off the entire balance of the ecosystem (Termini and CSP 2006).

funded by the UNDP GEF facility (under the LDC-SIDS Portfolio) and being conducted under the supervision of the Office of Environment and Emergency Management (Sustainable Development Unit) at the national capital in Palikir, Pohnpei. The ongoing SLM actions are directly consistent with the mainstreaming process in terms of including the conservation of land and biodiversity in development efforts, as this is actually the primary thrust of the program. Some of the objectives include development of individual, institutional and systemic capacity for sustainable land management practices, mainstreaming of SLM considerations into national development strategies and policies, to improve the quality of (infrastructure) project design and implementation and the development of a national action plan in this regard. States are working on projects that will include the development of integrated watershed management plans, increased forest and land monitoring through surveys and mapping, enhanced utilization of environmental impact assessment technologies available, development of waste management plans, and the identification and rehabilitation of degraded land areas, amongst others (FSM SLM 2005). This is a three-year program that should allow the nation to make great strides where it is much needed (as identified in detail in **Chapter 1**), and adds to the current efforts to increase the amount of forest under official protection, as part of the integrated ecosystem protected area program of work ongoing within the nation (see **Table 17** below).

TABLE 17: State endorsed protected areas in FSM, by type[103]

Protected Area category	Quantity	Area (hectares)
Watershed/upland forest reserve	2	5,880
Hunting reserve	2	28.7
Marine sanctuaries	12	9,158
Underwater monument	1	6,000
Biosphere reserve	1	1,772
Local marine managed areas	2	38,130
Park	1	6
Marine protected area	1	720
Total number of PA's	**22**	**61,694.7**

Source: FSM CBD Programme of Work on Protected Areas, 2007



Source: CSP, 2009

Additionaly, other policy, capacity, and funding-related forestry prerogatives are ongoing toward the overall effort of mainstreaming biodiveristy considerations, including a recent learning exchange between the states of Kosrae and Pohnpei on watershed management and protection (CSP 2009) facilitated by two of the leading conservation NGOs(KCSO and CSP), a five-year integrated watershed policy protection program for Pohnpei and Chuuk through the national Dept. of Transporation, Infrastructure and Communications, and a US Forest Service strategic initiative facilitated through the national Department of Resources and Development that will conduct state-wide forestry assessments and develop associated forest resource strategies (Friday 2009).

[103] This table identifies 22 total protected areas for FSM; Conservation International has indicated a total of 31 PA's for the FSM (Raynor 2003). In any case, the number is likely greater than 22, as there have been a number of additions, including some ongoing marine protected area and watershed reserve projects in Yap, Chuuk and Kosrae, three mangrove reserves in Pohnpei as well as another designation of a UNESCO Biosphere Reserve in Pohnpei (see *Chapter 1, pg. 77*) which are not included in this table.

3.2.4 Energy

Energy is a central and cross-cutting sector in the FSM, particularly as it relates to the current Administration mandate to move toward greater integration of renewable sources of energy into all development projects[104]. In early 2008, the FSM for the first time developed a Renewable Energy Unit in a ramped up Energy Division within the Department of Resources and Development. This unit was effectively implemented through the European Union's 9th European Development Fund, administered by the Pacific Islands Forum Secretariat, which was the first EDF facility that the FSM participated in since signing the EU-ACP Partnership Agreement in 2000[105]. Through the EDF9, FSM was able to begin to integrate renewable energy power into schools, dispensaries and other government buildings on one of the high and several of the main outer-island groups of the nation[106] (**Table 18**) , thereby reducing not only the carbon footprint, but also the need for expensive and pollutive diesel-powered generators on these islands. This program – Support to the Energy Sector in Five ACP Pacific Islands, or REP-5 – is now drawing to a close and the FSM is well into the planning for the EDF10, which will double in scope and size and continue to integrate the utilization of alternative, renewable sources of power into society. Expected outcomes of the long-term vision toward less dependence upon fossil-fuel throughout the nation will be to provide affordable and clean power, increase economic activity and opportunity, improve educational opportunities and health services, and reduce government operational costs at all levels. FSM has completed an Energy Efficiency Action Plan and is finalizing its National Energy Policy, a cross-sectoral, cross-cutting policy document.

TABLE 18: National Renewable Energy Projects under EU-EDF9 in FSM

State	Projects
Chuuk	Outer islands of Onoun, Moch, Udot and Satawan: electrification of schools and health centres by solar PV systems and mini-grids
Kosrae	Five Grid-connected PV systems: The State capitol building; Kosrae international airport; the hospital; Kosrae Utilities Authority and the Legislature building
Pohnpei	Outer islands of Mwoakilloa, Pingelap, Kapingamarangi, Sapwuafik and Nukuoro: electrification of schools & health centres by solar PV
Yap	Ulithi atoll islands of Fadrai and Asor: electrification of schools, health centres and households by solar PV mini-grid
National	Training in off-grid and grid-connected PV-systems; Development of an energy policy; Solar lanterns supply and distribution; Energy efficiency activities (energy officer, energy audits, energy efficiency action plan)

Source: REP-5 PMU 7th Progress Report, 2009

[104] President Emanuel Mori has put the FSM at the forefront of the regional RE movement; Strategic Goal 3 of the SDP environment sector strategy calls for the reduction of fossil-fuel use and the conversion to renewable energy sources.

[105] EU-ACP stands for, European Union – African, Caribbean, Pacific; the EU-ACP Partnership Agreement is also known as the Contonou Agreement, named after Contonou, South Africa, from whence it emminated.

[106] The islands that had PV-arrays installed are in Pohnpei (Sapwuahfik, Nukuoro, Kapingamarangi, Pingelap, Mwoakilloa), Chuuk (Moch, Satawan, Onoun), Yap (Asor, Fedrai) and the main island of Kosrae.

3.2.5 Agriculture

The agriculture sector, like fisheries and tourism, is expected to be one of the three primary drivers of economic growth in the FSM over the long term (Wortel 2004). While, in fact, agriculture, as a collective effort throughout the FSM, already is one of the primary economic activities of the country, in both official and unofficial terms. Indeed, agriculture, as a sector, is likely the most fully socio-eco-enviro integrated sector of all: in its traditional form (see **Chapter 1**) it carries forward a host of not only biological care and knowledge, but also cultural practices that in many cases provide a balance to daily village life. A full 80% of the FSM populace depends upon subsistence or semi-subsistence agriculture for their livelihoods (ADB 2005)[107]. Large scale commercial agriculture utilizing industrial methods does not exist. In short, within the nation it is a major part of local economies, providing livelihood and employment to much of the population, but externally it is not a major contributor to export receipts (ADB 2005).

Again, the states of the FSM retain control of their land and as such, there is no overarching agricultural policy for the FSM. However, there are local and national programs in scope that effectively act as components of a larger strategic plan to promote sustained and sustainable farming practices for the benefit of health and local diets as well as local economies and income opportunities[108]. The national government has a Division of Agriculture, as do each of the state governments, mandated for overseeing the sectoral activities contained within the national strategic development plan toward this end. The College of Micronesia also has a well-developed extension program that it implements throughout the nation adhering to the guiding goals of the SDP, which are to 1) Enhance a focused agriculture sector operating within a stable policy framework, 2) Support traditional farming systems for home nutritional needs and cash incomes, 3) Increase surpluses to be marketed by private sector into local and regional markets, and 4) Promote environmentally sound and sustainable production. Currently, two nationally-facilitated programs are ongoing that integrate the environmental ethic into agricultural activities in the FSM, and implement the strategic goals of the SDP: the EU-funded Development of Sustainable Agriculture in the Pacific (DSAP) program, which falls under the guidance of the FSM Department of Resources and Development, and the UNCCD Sustainable Land Management program ongoing, which seeks to institutionalize best agricultural practices in tropical ecosystems and to maintain ecosystem services. Finally, there has been extensive awareness-raising, research and monitoring in this sector through the NGO, Island Food Community of Pohnpei (see **Chapter 2** *NBSAP Implementation Status Table*), which now has programs throughout the federation in an effort to promote sustainable agricultural practices and diets.

Source: IslandFood.org, 2010

[107] A recent survey on Pohnpei (2000 Census) showed the value of average agricultural production per household at $4,700 in 2003, equivalent to 74% of median household income. However, only 25% of this came from market sales; own consumption accounted for about 53%, and 22% was used for ceremonial activities or to fulfill social obligations.

[108] There is room for import substitution on a limited scale. In 2002, food imports totaled $28.2 million, of which about $1.4 million were for fruit and vegetables that could be produced locally (ADB 2005).

3.2.6 Tourism

Tourism in the FSM is a relatively small-scale enterprise (**Table 19**) and thus impacts to the natural environment are somewhat minimal. Yet, national ambitions for the tourism sector to help develop the economy remain ambitous, placing this sector at the crux of the biodiversity/development fulcrum. While it remains one of the strategic growth sectors for national economic growth (SDP 2003), many people in the wider community in all the states have consistently expressed concerns about potential negative impacts of tourism on both the socio-cultural fabric and the natural environment of the FSM (ADB 2005). While the SDP lays out some clear outcomes in terms of growth[109], there is also a clear mandate for the integration of biodiversity concerns into the sector, with cross-sectoral relationships with the national environmental strategy (SDP 2003):

- At least one successful ecotourism enterprise is established for 50 % of all conservation areas in the FSM by 2010, including environmentally compatible economic development enterprises; and,
- Develop in-country sources of funding and investment for environmental and sustainable initiatives, including resource rentals and/or royalties, user fees for tourism activities, environmental bonds for development projects, and special taxes for visitors and tourists.

TABLE 19: International visitor arrivals to the FSM by nationality

Nationality	1996	2000	2001	2002	2003	2004
Asia	2,029	2,890	2,255	2,680	2,877	3,152
Europe	1,007	1,427	1,235	1,343	1,668	1,353
Japan	5,519	4,661	3,194	4,061	3,984	3,661
Pacific Islands	2,282	2,151	1,589	2,150	1,932	2,425
USA	7,083	8,605	6,966	8,152	7,736	7,101
Other	239	304	255	314	299	312
Total	**18,159**	**20,038**	**15,494**	**18,700**	**18,496**	**18,004**

Source: ADB Economic Report for FSM, 2005

Despite the FSM's distance from major tourism origin markets and the consequent high cost and inconvenience of travel, the nation offers many attractions for selected niche markets: a pristine marine environment, tropical scenery and diverse plant and bird life, traditional cultures – all in sparsely populated, clean environmental settings outside the district center urban areas. For the sophisticated and experienced tourism markets that are looking for something different, the FSM's isolation is a potential selling point for niche markets such as eco-tourism, cultural tourism, water sports, and other special interests, e.g., traditional plant medicines, bird-watching, and social anthropology (ADB 2005). To be sure, ecotourism is perhaps one of the

[109] The tourism strategy mission statement: *Progressively develop the tourism sector to become the leading sustainable economic activity in the nation, and establish the FSM as a top quality, premium-priced international tourism destination by 2020.* With this in mind, in order for the existing hotel stock to achieve the desired average occupancy rate (65 percent) by 2010 (Strategic Goal 1, Outcome 3), annual tourism numbers need to more than double to 42,000, while the 1st Economic Summit set a target of 100,000 annual visitors, also contained in the National Tourism Marketing and Promotion Action Plan; these arrivals totals would be worth, in terms of gross earnings, some $39 million and $94 million respectively per annum.

clearest areas where the FSM directly bases ecological considerations as a prerequisite to economic development, and there is a natural competitive advantage.

Eco-tourism focuses on local cultures, wilderness adventures, volunteering, personal growth and learning new ways to live on our vulnerable planet[110]. It is typically defined as travel to destinations where the flora, fauna (both terrestrial and aquatic), and cultural heritage are the primary attractions. Responsible eco-tourism includes programs that minimize the adverse effects of traditional tourism on the natural environment and enhance the cultural integrity of local people. Therefore, in addition to evaluating environmental and cultural factors, initiatives by hospitality providers to promote recycling, energy efficiency, water re-use and the creation of economic opportunities for local communities are an integral part of eco-tourism (Lintz 2009).

Indeed, excellent examples of such high-end eco-tourism do exist, with the Kosrae Village Ecolodge and Resort and the Pohnpei Village leading the way for many years now. Kosrae Village in particular goes quite far in terms of its proactive approach to the environment, consistently working with the state on key environmental initiatives, such as the establishment of the vaunted mooring buoy system on the fringing reef around the island[111], and being a central player in the ongoing coral monitoring program, both of which assist in the protection and monitoring of biodiversity. Kosrae Village Resort has been named as one of *National Geographic*'s Top Fifty Eco Lodges worldwide (Lintz 2009).

With the expected completion of the enlarging and extension of the Pohnpei International Airport – the primary hub into the nation – by early 2011, direct and larger flights from Asia will become more common, driving the economic growth that the tourism industry in FSM seeks. How environmental considerations are consistently integrated into that growth process will obviously be a large challenge moving forward[112]. Successful tourism must benefit local populations economically and culturally to give them incentives to protect the natural resources which create the attraction. The FSM National government is certainly fully committed to promoting the expansion of eco-tourism activities and services in the context of low-impact and culturally-sensitive tourism (Lintz 2009) toward the end of creating needed income opportunities in communities on a sustainable basis. Inherent in such a policy can be seen the accumulation of the three main goals of the CBD: conservation of biodiversity, sustainable use of its components, and fair and equitable sharing of benefits arising from genetic resources.

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[110] According to the World Tourism Organization, eco-tourism is considered the fastest growing market in the tourism industry with an annual growth rate of 5 percent worldwide and representing 6 percent of the world gross domestic product and 11.4 percent of all consumer spending – not a market to be taken lightly. However, in an era of heightened environmental consciousness and accessibility to exotic locales, countries around the world are busily promoting their natural and cultural resources as lures for tourists. This creates a distinctive challenge for the FSM to differentiate itself in the world eco-tourism market with the diminutive promotional budget allocated to the State Visitors Bureaus, which are mandated to promote themselves as a destination while at the same time preserving and strengthening the island's tourism resources (Lintz 2009).

[111] Strategic Goal 4, Output 4.3.7 of the tourism development strategy: *Mooring buoy network for dive and snorkel boats established in main islands by 2009.*

[112] The government of Japan has provided the funding for the airport project, so many of the direct flights will originate in Japan. It should be noted that Japan is the world's second largest economy whose citizens have considerable purchasing power for leisure; Continental currently has over 60 flights a week to Guam from 8 Japanese cities. However, tourism is not the only consideration into the runway expansion project, fisheries is also a primary factor: larger planes flying direct to Japan from Pohnpei will also mean more fish being sent off island direct to Japanese markets on a more frequent basis.

3.3 The ecosystem approach

Through international co-operation in the context of the CBD, a set of principles and guidelines has been developed for a model known as the *ecosystem approach*, which aims to provide a comprehensive overview for the purposes of planning the conservation, management and sustainable use of natural areas and natural resources. The ecosystem approach stresses the importance of preserving in various ways the natural ecological structures and functions of habitats so as to safeguard beneficial natural values and processes known as *ecosystem services*. The ecosystem approach to development initiatives is best reflected within the FSM through its environment strategy matrix in the national strategic development plan[113]. The SDP national environment strategy – developed in 2003 - was itself formed and guided by the NBSAP (2001), primarily. Other relevant national planning strategies that reflect this approach are the national Climate Change Policy, the draft national Solid Waste Management Policy, which itself is an extension of the UNCCD SLM program discussed earlier in this chapter, and crucially, the First FSM (UN) Millenium Development Goals Report. The MDG's, which are to be achieved by 2015, are currently being linked into the national SDP priorities, and are also being utilized to develop the National Sustainable Development Strategies (NSDS) - a national budget process linked to priority sector strategies. In addition, the national government is also in the process of integrating the MDGs and NSDS into the National Planning and Budgeting Framework (FSM 2010)[114].

The above are merely documents and guidelines to processes of course; what, if anything, can we say about the on-the-ground actions that have been undertaken and their impacts toward implementation of the Convention? While the national government has been active in the formulation of policy, it is quite important to note that in regard to safevauching the ability over time for ecosystems to continuously provide those services that humans rely on has often been a function of the NGOs in the FSM. This is largely in regard to working with villages and communities in the establishment of conservation areas, where government is often not able to be effective due to perceived notions of control over traditional freedoms in forest and reef areas. In any case, NGOs have and do work well in this area, and have recently been working with communities and government agencies together – often as a go-between - protecting watershed forests (water resources), and establishing and assisting in the monitoring (sometimes taking the lead) of established marine protected areas, where conservation of aggregation and spawning sites for species has a natural spill-over effect to surrounding habitats and ecosystems. Ultimately, this sort of broad-based ecological mindset has the same spill-over effect on society: fishers are able to continue providing for their families and sell to local markets; markets are able to make a small profit and pay employees and sell to the general populace; the general populace is able to enjoy its favorite (and healthiest) foods and feel at ease that this food remains available to them; improved diets thus lead to less tax on the health care systems which are largely government subsidized; the NGOs,

[113] Strategic Goal I of the environment strategy, for example, is to "Mainstream environmental considerations, including climate change, into national policy and planning as well as in all economic development activities." It includes as one of its outcomes to "Promote and support sustainable land use and development planning in rural areas and outer islands," both of which make up the majority of the land area of the nation.

[114] Ecosystem services are a major impetus behind almost all of the UN's Millennium Development Goals. Biodiversity thus plays an important role in economic development as a whole, in addition to its importance in the overall consideration of environmentally sustainable development (Finland 2009).

communities and government agencies steer their employment and systems toward the protection of nature rather than the destruction of it for survival; and so forth and so on in a positive closed loop. This being the case, one can say that the NGO, or civil sector, is in many ways the most highly integrated sector in the nation, considerate of social implications as a means to an end, with a mission that dictates that it adhere to biodiversity conservation, and the neccessity of garnering external revenue streams and creating lasting jobs around their sustained operations as part of the overall functioning of the macroeconomic fabric of the nation. As the NGO sector becomes more entrenched and more accepted, so too will the ecosystem approach throughout society, and more importantly, the ecology of place within the development and policy process at all levels of government.


Biosphere Reserve: The Beginning of a New Era

The first in the nation is also a first for Kosrae; The challenge will be mixing traditional with modern conservation practices.

BY OLIVIER WORTEL

"It's not right to be too tough. An overpowering enforcement will not work. Just take it easy. Talk sweet and safely and peaceful."

KOSRAE ISLAND RESOURCE MANAGEMENT AUTHORITY (KIRMA)

UTWE BIOSPHERE RESERVE

UTWE VILLAGE

NO FISHING ALLOWED

TIA LELA IN SRUOK KUTENA MA OASR

MOUL LA IN POLOA ACN SE INGE

Source: Kosrae Conservation and Safety Organization

On a final note for this section, though there are a multitude of examples for the aforementioned already cited (see **Chapter 1** boxes on pgs. 38 and 77), on a national level, perhaps the best current example is the highly collaborative and integrated FSM Protected Area Network (PAN) program ongoing. The PAN of course extends out of the CBD Programme of Work on Protected Areas and has been instrumental in facilitating an eco-ethos between multi-levels of government, NGOs and communities, working toward national and regional Convention goals: determining conservation and data gaps, developing and implementing capacity building, establishment of state working groups, and ultimately, working toward the ambitious goals of the Micronesia Challenge (see **Chapter 2**). The PAN coordination is conducted out of the FSM Department of Resources and Development, with assistance from The Nature Conservancy.

3.4 Biodiversity in environmental impact assessment

According to FSM environmental impact assessment regulations – contained within Title 25: Environmental Protection, of the FSM Code – biodiversity is a primary consideration when conducting environmental or strategic impact assessments. Title 25 has a number of chapters and sections, one of which is the formulation of a Board, which in this case is the SD Council discussed in previous sections of this report. According to Chapter 2, Section 6 of the Code, "*The Board shall balance the needs of economic and social development against those of environmental quality and shall adopt regulations and pursue policies which, to the maximum extent possible, promote both these needs and the policies set forth…*" The Board/SD Council has a number of broad and authoritative functions related to earth moving and reporting on status of biodiversity and threats, however as been noted, this body is in need of some reformation (NBSAP 2002, SDP 2003, ADB 2005). More salient for this section however are the Environment Impact Regulations that implement Section 13 of the FSM

Environmental Protection Act. The purpose of these Regulations is to establish standard procedures for preparation of an environmental impact assessment statement prior to taking or funding any major action that may significantly affect the quality of the human environment. The Environmental Impact Assessment (EIA) process is intended to help the general public and government officials make decisions with the understanding of the environmental consequences of their decisions, and take actions consistent with the goal of protecting, restoring, and enhancing the environment. These Regulations provide the directions to achieve this purpose. In addition, these Regulations are designed to: (a) Integrate the EIA process into early planning of projects to insure timely consideration of environmental factors and to avoid delays; and (b) Identify at an early stage the significant environmental issues requiring further study and de-emphasize insignificant issues.

EIA's are required for all projects that may (*Appendix A - Examples of Significant Impacts*):

- Conflict with adopted plans and established uses of the community where it is to be located.
- Have a substantial, demonstrable negative aesthetic effect.
- Substantially affect a rare or endangered species of animal or plant or the habitat of such species.
- Interfere substantially with the movement of any resident or migratory fish or wildlife species.
- Substantially diminish habitat for fish, wildlife, or plants.
- Breach standards relating to solid waste or litter control.
- Substantially degrade water quality.
- Contaminate a public water supply.
- Substantially degrade or deplete ground water resources.
- Interfere substantially with ground water recharge.
- Extend a sewer line with capacity to serve new development.
- Encourage activities which result in the use of large amounts of fuel, water, or energy.
- Use fuel, water, or energy in a wasteful manner.
- Disrupt or adversely affect an archaeological site or a property of historic or cultural significance.
- Induce substantial growth or concentration of population.
- Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system.
- Displace a large number of people.
- Increase substantially the ambient noise levels for adjoining areas.
- Cause substantial flooding, erosion or siltation.
- Expose people or structures to major geological hazards.
- Create a potential public health hazard or involve the use, production or disposal of materials which pose a hazard to people or animal or plant populations in the areas affected.
- Violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations.
- Convert prime agricultural land to non-agricultural use or impair the agricultural productivity of prime agricultural land.
- Interfere with emergency response plans.

Furthermore, Appendix B of the Act provides state resource agencies with an Initial Assessment Environmental Checklist of specific questions related to impacts on Earth, Air, Water, Plant Life, Animal Life, Noise, Land Use, Natural Resources, Risk of Upset, Population, Housing, Transportation, Public Services, Utilities, Human Health, Aesthetics, Recreation, and Cultural Resources[115]. How local laws, regulations, politics and boards function ultimately determine how adverse impacts on biodiversity are ameliorated or prevented. Final conclusions from EIA's often gloss over environmentalist concerns. In FSM sound policy exists but not always practiced, which is the very nature of development (Gale 2009).

[115] Some sample questions are, Will the proposed project result in destruction, covering or modification of any unique geologic or physical features?; Substantial air emissions or deterioration of existing air quality?; Changes in absorption rates, drainage patterns, or the amount of surface runoff?; Destruction of any upland or mangrove forest communities?; Destruction of any coral reef areas?; Changes in existing housing or create a demand for additional housing?; Obstruction of any scenic vista?

3.5 Outcomes achieved

"The South Pacific Forum at its meeting last month adopted the Convention to Ban Importation Into the Forum Island Countries of Hazardous and Radioactive Wastes and to Control Transboundary Movement and Managements of Hazardous Wastes within the South Pacific Region, also referred to as the Waigani Convention. It is an important arrangement that strengthens and supplements the effect of the Basel and London Conventions within our region…An established principle of international law prescribes that a State must ensure that its actions within its jurisdiction or control do not cause damage within other States or within areas beyond the limits of its national jurisdiction. That principle is embodied in Article 4 of the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, otherwise known as the Noumea Convention. Together with nine Pacific countries and the United States, France is a party to that Convention. It is also an expressed principle in the Convention on the Biological Diversity, to which France is also a State party…The Noumea and Biodiversity Conventions also contain clear requirements for advance, transparent environmental impact assessments of projects which might have harmful impacts on the environment. No in-depth, comprehensive environmental impact assessment of France's underground nuclear testing program in the South Pacific has ever been carried out." These were the remarks of the Honorable Asterio Takesy, Secretary of External Affairs for the FSM, delivered at the General Debate of the Fiftieth Session of the General Assembly of the United Nations, New York, 3 October 1995, on France's intention to conduct nuclear testing in the region.

More recently, in December 2009, adhering to its national and international commitments to the UN Convention on Climate Change – an attempt to again take a proactive stance on the global stage to in some way head off the disastrous effects of climate change to the people and other biological wealth of the FSM, President Emanuel Mori made a legal request to the government of the Czech Republic concerning the expansion of the Prunerov II coal-fired power plant. Prunerov II CO_2 emissions are more than 40 times higher than those of the entire FSM combined (Greenpeace 2009). In its official submission of 4 January 2010, FSM stressed that the climate impacts of the project had not been assessed in the original EIA and argued that the Czech Ministry of Environment should issue a negative final statement on the environmental impact assessment for the project proposed by CEZ. The 1991 Espoo Convention on Environmental Impact Assessment in a Transboundary Context is the principal treaty focusing exclusively on transboundary EIA. The Convention addresses transboundary impacts to the state Parties. The Czech Republic signed the Espoo Convention in 1993 and ratified it in 2001. All other EU Member States are also Parties to


The National Union

Peace Unity Liberty

AN OFFICIAL PUBLICATION FOR THE PEOPLE OF THE FEDERATED STATES OF MICRONESIA

Volume 30 Palikir, Pohnpei, November 06, 2009 Number 14

President Addresses European Leaders on Climate Change at European Development Days

President Mori shakes hands with Dr. Rajendra K. Pachauri, Chairman of the International Panel on Climate Change (IPCC) at the European Development

Recent Natural Disasters

The National Union

Peace Unity Liberty

AN OFFICIAL PUBLICATION FOR THE PEOPLE OF THE FEDERATED STATES OF MICRONESIA

Volume 28 Palikir, Pohnpei, October 09 , 2009 Number 12

Micronesia President Emanuel Mori Urges Immediate Action on Climate Change

President Mori stands before the 64th United Nations General Assembly on September 25th to give his address.

Executive Branch Signs $35 Million FSM Budget for FY2010

Source: FSM Public Information Office, 2009

the Convention. "*Within just a few generations*," stated Mori in Stockholm, Sweden, in October 2009, "*we have become the front line of a global crisis that threatens not only our water supplies, our agricultural productivity and our ocean resources, but also our very existence*."

In recent years, the FSM has also taken action locally to implement programs that adhere to the Montreal Protocol on Substances that Deplete the Ozone Layer, the 1990 Soil and Water Conservation Agreement Between the United States of America and Micronesia, and the Stockholm Convention on Persistent Organic Pollutants. All of these are serious efforts to directly affect external threats to the national biodiversity components. Contributing to the implementation of the NBSAP, the FSM is now working on a Sustainable Land Management program (UNCCD) toward a successful outcome of mainstreaming SLM into national policies and strategies, including major infrastructure development projects. This is an important initiative in that Infrastructure is the largest single sector in the federation over the next 15 years and beyond, and therefore will have far-reaching social, economic and environmental impacts over the long term. The goal is to ensure negative impacts are minimized or avoided completely. Moreover, the SLM program is now also working toward strengthening the capacity of all relevant stakeholders to utilize the environmental impact assessment regulations in place to their fullest optimum effect.

In addition, as introduced in **Chapter 2** and further discussed in a previous section of this chapter, the Micronesia Conservation Trust is a singular outcome achieved, not only for the FSM, but the entire North Pacific. Along with the Programme of Work on Protected Areas, the ongoing development of a nation-wide Protected Area Network has successfully brought together better than ever before government and NGOs and communities toward an overaching goal of achievement of the seminal Micronesia Challenge, an initiative that, if successful, will certainly assist to mainstream conservation of biodiversity.

Through these means and other efforts ongoing – the integration of the Millenium Development Goals and the National Sustainable Development Strategy into planning and budgeting processes, the European Development Fund Renewable Energy Programme, promotion of real ecotourism - biodiversity integration measures are hoped to help offset and perhaps reverse many of the larger trends of biodiversity loss, particularly through local anthropogenic factors. Already, the implementation and cross-sectoralization of these efforts are having a profound effect on the nation, and a clear shift in mindset is also apparent. Governments and communities are eager to embrace modern methods and technological means to live sustainable lives, as the people of this nation have for thousands of years.

Attaining a comprehensive goal of complete cross-sectoral integration of social, economic and especially biodiversity standards will be facilitated by the active participation of private sector businesses, and governmental, non-governmental, and other agencies, organizations, and institutions. Ultimately however, the key to achieving the conservation and sustainable use of the FSM's coral reefs and associated ecosystems resides within the local communities. The people who live, physically and spiritually, as a natural part of these fragile ecosystems will have to decide whether or not to make the commitment for themselves, and on behalf of their future generations, to adopt and implement a comprehensive, fully participatory, community-based management approach to their environment (FSM Climate Change Response Strategy 2008).

Chapter IV
Conclusions: Progress Towards the 2010 Target

"If the people are comfortable and well taken care of then they can start thinking about conservation. There is a light at the end of the tunnel, but the basic needs of the people need to be met first. We need to have a more wholistic approach to these communities, take care of mandates and needs first and then talk about conservation. Conservation is more long-term, so we need to be more open minded to these communities and address issues that are more important today, before we start talking about tomorrow."

---A quote from Charles Chieng of Yap State, FSM, Micronesia Conservation Trust Chairman and Director of YapCAP, one of the leading conservation organizations in the region, speaking at the 6th Micronesians in Island Conservation meeting in Pohnpei in 2005.
(Source: The Micronesian Alliance, Volume 1, Issue 11.)

Chapter 4

4.1 Introduction

One of the most fundamental issues in the realization of biodiversity conservation is the value that we place on the environment, in all its aspects. This is not just about material gains and human centered development, but values based on a deep-seated respect for the environment, based on a moral standard. Aldo Leopold developed a land ethic based on the principal that a thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise[116]. In FSM the challenge is to inculcate an environmental ethic that underpins individual, community and institutional behavior (Tuvalu 2009). The ongoing environmental education programs[117] and the community consultations undertaken so far by the nation's NGOs in particular have been geared to nurturing such an ethic. There might appear to be a long way to go, but the underlying philosophy is that people's behavior will change when they become conscious of their actions and have tangible alternatives to their present, sometimes deleterious actions. Tangible alternatives can begin to be realized once municipal, state and national legislative bodies, councils and the like ensure that basic social services and needs are addressed first; only then can individuals and communities have the luxury of considering conservation as a viable long-term goal[118]. A related issue is the contribution of biodiversity conservation to rural livelihoods and to poverty alleviation, and vice-versa. As has been presented in Chapter 1, working toward a dminishment of hardship and putting in place incentives and subsidies will go a long way toward stewardship, rather than a stripping of ecosystem services by the poor.

This chapter deals with an analysis how activities on the national level in FSM contribute to the fulfilment of the objectives adopted by the Conference of the Parties in 2010 and to the fulfilment of the objectives defined by the National Biodiversity Strategic Action Plan. The analysis is focused on the monitoring of adopted national strategic objectives, strategic orientations and concrete tasks of the NBSAP in FSM and in the national Strategic Development Plan (SDP) and other relevant sectoral and non-sectoral strategies and action plans, in relation to the global and national objectives mentioned in the two documents. The summary analysis is based on the information introduced in the previous chapters of the Fourth National Report. It is presented in table format to provide an easier glimpse into achieved outputs, obstacles and needs ongoing.

[116] Leopold, A., 1949. A Sand Country Almanac. Oxford University Press, New York.

[117] The Conservation Society of Pohnpei dedicates an entire division to Environmental Education, which serves as one of its core functions; CSP's ongoing Green Road Show and Youth to Youth education programs in the schools of Pohnpei attempts to integrate environmental principles with children early in life in order to develop an environmental ethic. The Green Road Show has been emulated by other conservation NGOs in the nation due to its success.

[118] Charles Chieng, Director of the Yap Community Action Program (YapCAP) has been one of the more successful and outspoken conservation leaders in the region, and continues to be; in any case, it was Chieng who pointed this salient point out in the 6th Micronesian's in Island Conservation (MIC) meeting in Pohnpei, where villagers in an upland forest continue to clear native forest inside the Watershed Forest Reserve boundary line in Pohnpei for growing Sakau, which is a primary source of income for at least 90% of families.

4.2 Progress toward the 2010 targets

Goals and Targets	Relevant indicators
Goal 1: Promote the conservation of the biological diversity of ecosystems, habitats and biomes.	
Global Target 1.1: At least 10% of each of the world's ecological regions effectively conserved. National Target: At least 20% of terrestrial and 30% of marine ecosystems effectively conserved (Micronesia Challenge). FSM SDP: • At least 20% of the nation's coral reefs are protected as "no-take" reserves by 2020. • Deforestation/ Agricultural conversion rates are decreased to 0% by 2010.	Coverage of protected areas: • 5,880 ha (~10% of total land area) in terrestrial PA network (ADB CEA 2007). • 39,902 ha under LMMAs and Biosphere Reserves (Pohnpei BR area not included) • 16 community marine/fisheries reserves (area not available) Trend in extent of selected biomes, ecosystems and habitats: • Terrestrial ecosystems – Possible designation of three more forest reserves within the next two years on Kosrae (Olum and Yela) and Chuuk (Oroor). • Marine ecosystems – continued growth and expansion of marine areas under village based conservation projects is expected. Trends in abundance and distribution of selected species : • Endemic bird species – most are vulnerable with declining populations in the wild except for Pohnpei Mountain Starling, which is possibly extinct. Most could possible be stable, but hard to determine without further study; hunting, typhoons and habitat loss are perils. • Turtles – no availabe data, but like birds, habitat loss and overharvest pose big risks. • Nearshore fisheries – abundance in decline due to unsustainable harvest as indicated by recent REAs (market surveys) in all States; future trend appears to be the same. • Freshwater fauna – comprehensive preliminary studies not completed.
Global Target 1.2: Areas of particular importance to biodiversity protected National Target: At least 20% of terrestrial and 30% of marine ecosystems effectively conserved (Micronesia Challenge). FSM SDP: • 50% of FSM municipalities legally designate at least one marine or terrestrial site (using the ABS sites identified in ecoregional plan developed under the NBSAP) as a conservation area by 2010.	Trends in extent of selected biomes, ecosystems and habitats: • 7 of 24 ABS Priority Action Areas are under some form of conservation management – Ahnd Atoll, Dalipebinaw School Forest Reserve, Fefan Forest, Pohnpei Central Forest, Utwe-Walung Marine Park, and Yela-Okat Terminalia-Mangrove (partial). • Work is ongoing, but most of the remaining 17 remain highly vulnerable to degradation. Trends in abundance & distribution of selected species: no available data. Coverage of protected areas: • All 7 Priority ABS are within the existing PAN; it is expected that the PAN will increase.

Goals and Targets	Relevant indicators
Goal 2: Promote the conservation of species diversity.	
Global Target 2.1: Restore, maintain, or reduce the decline of populations of species selected taxonomic groups. Global Target 2.2: Status of threatened species. National Target: FSM's native, endemic, threatened and traditionally important species are protected and used sustainably for the benefit of the people of the FSM and the global community (NBSAP, Theme 2).	Trends in abundance and distribution of selected species; including status: • 3 IUCN Redlisted turtle species (Green sea turtle, Leatherback and Hawksbill turtle) are assessed as declining in numbers; no assessments available but likley declining. • 4 IUCN Redlisted bat species: Caroline sheath-tailed bat, Chuuk, Pohnpei and Mortlock fruit bats critically endangered; no surveys have been conducted; remain threatened. • 3 IUCN Redlisted molluscs (land snails): *Partula guamensis*, *emersoni* and *martensiana* crtically endangered; no assessments have been completed, but may face declining populations. • 11 IUCN Redlisted birds: Pohnpei mountain starling, Chuuk white-eye, Chuuk monarch, Pohnpei short-eared owl critically endangered; Caroline ground dove, White-throated ground dove, Yap monarch, Bristle-thighed curlew, Large Pohnpei white-eye, Plain white-eye and Yap olive white-eye are vulnerable; assessment conducted in Pohnpei in 1994 suggests declining populations; need for updated assessments. • 3 IUCN Redlisted plants: "Looking-glass tree", Ivory nut palm, Korom vulnerable; no assessments available, but these continue to decline, with others likely added to list.
Goal 3: Promote the conservation of genetic diversity.	
Global Target 3.1: genetic diversity of crops, livestock and of harvested species of trees, fish and wildlife and other valuable species conserved, and associated indigenous and local knowledge maintained. National Target: Increase production of traditional farming systems for home nutritional and traditional needs and cash incomes (FSM SDP – Ag. Matrix, SG2).	Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socio-economic importance: • Taro's (*Colocasia esculenta*) genetic diversity actively being expanded to improve resistance to Taro Leaf Blight, and other Taro diseases. Varieties are often traded between islands. • Coconuts (*Cocos nucifera*) and banana (*Musa spp*) are also part of ongoing genetic improvement, introduction and reseeding programs; awareness programs on growing traditional varieties also ongoing (e.g., Karat). • Several species and varieties of disease-resistant citrus trees are also being propagated. • Freshwater species introductions for aquaculture include – 1 tilapia species (*Oreochromis mossambicus*). • Domesticated animals – goats, caribou, cows, pigs, dogs and deer have been introduced. Trends in abundance and distribution of species: • All new varieties of taro, bananas, coconut, and fruit trees are now distributed for planting. • Tilapia: anecdotal accounts of accidental introductions into local streams. • Status and distribution of the freshwater prawns (and eels) introduction is not known. • Pigs and dogs exist on all main islands; goats on KSA and PNI; carbou, deer, cows PNI only.

Goals and Targets	Relevant indicators
Goal 4: Promote sustianable use and consumption.	
Global Target 4.1: Biodiversity based products derived from sources that are sustainably managed, and production areas managed consistent with the conservation of biodiversity. National Target: Promote environmentally sound and sustainable production (FSM SDP – Ag. Matrix, SG4).	Area of forest, agricultural and aquacultural ecosystems under sustainable management: • Forests – none; there is no land dedicated to, say, timber production or the like; although there are some mahogony plantations they are not under a SM type regime. • Agriculture –6 organic commercial farms (area unknown); undetermined if there are more farms being planned, however Farmers Associations are active in small-scale production. • Aquaculture – 1 state-run mangrove crab pond in Kosrae, giant clam and coral farming in KSA and PNI (MMME and MERIP), several pearl, oyster and sponge farms throughout FSM (area unknown); trainings administered and more aquaculture farming activity expected. • Marine trophic index – extremely limited data; fisheries are in decline. • Nitrogen deposition – no data. • Water quality in aquatic ecosystems – assessments show at least 8 main rivers unsafe for recreational use in Pohnpei, and there is no management; Kosrae has placed 13 major rivers under legal protection; Yaps' main aquatic ecosystem is protected (area unknown).
Global Target 4.2: Unsustainable consumption of biological resources or that impacts upon biodiversity, reduced. National Target: Manage and protect the nation's natural environment – protect, conserve and sustainably manage a full and functional representation of the FSM's marine, freshwater and terrestrial ecosystems (FSM SDP – Env. Matrix SG5).	Ecological footprint and related concepts: Total land area under forest cover – PNI 74%, KSA 72%, Yap 54%, CHK 73%, or approximately 42,634 hectares (does not include mangrove forests); trends point to continuing loss of forest cover due to cultivation, harvest, roads, settlement and damage due to typhoons.
Global Target 4.3: No species of wild flora or fauna endangered by international trade National Target: FSM's native, endemic, threatened and traditionally important species are protected and used sustainably for the benefit of the people of the FSM and the global community (NBSAP Theme 2).	Change in status of threatened species: • Turtles – not exported; export banned. • Flying fox – not exported; hunting ban in place. • Corals – wild corals are not exported as it is illegal, however some farmed corals (aquaculture) are being exported from Kosrae (MMME). Overall coral health is good to excellent in FSM, however, climate change (typhoons, bleaching, etc.) may cause decline. • Birds – not exported; protection for several endemic species; Micronesian pigeon is in peril as seasonal hunting is still allowed (unknown whether pigeon is exported or not.)

Goals and Targets	Relevant indicators
Goal 5: Pressures from habitat loss, land use change and degradation, and unsustainable water use, reduced.	
Global Target 5.1: Rate of loss and degradation of natural habitats decreased. National Target: FSM's native, endemic, threatened and traditionally important species are protected and used sustainably for the benefit of the people of the FSM and the global community (NBSAP, Theme 2).	Trends in extent of selected biomes, ecosystems and habitats: • Forests – overall about 68% (1976); trend is likely declining; updated aeriel photography needed, along with detailed on-the-ground assessment in all terrestrial biomes. • Mangroves – 12% of total forest cover (1976); declining. • Wetlands – 2% of total forest cover (1976); declining. • Grassland/Fern sedge savanna – 7.5% cover (1976); declining. • Coastal marsh/beach strand - ~8% cover (1976); declining. • Marine trophic index – extremely limited data; fisheries (reef and oceanic) are in decline.
Goal 6: Control threats from alien invasive species.	
Global Target 6.1: Pathways for major potential alien invasives species controlled. National Target: Border control, quarantine and eradication programs are effectively protecting the FSM's native biodiversity from impacts of alien invasive species (NBSAP Theme 6).	Trends in invasive alien species: • Increased effectiveness of border control quarantine services at both international airports, and seaport; threats on the rise with increased air and seaport activity. • On-going activities to prevent inter-island spread of betelnut rot disease, Giant African Snails, Brown Tree Snake (Guam) and others. • Eradication activities targeting rats, Eurasian sparrow birds, Giant African Snails, Mile-a-minute vines, False Sakau, Crown-of-Thorns starfish and others continuing.
Global Target 6.2: Management plan in place for major alien species that threaten ecosystems, habitats or species. National Target: Establish effective biosecurity (border control, quarantine and eradication) programs to effectively protect the FSM's biodiversity from impacts of alien invasive species (FSM SDP – Env. Matrix SG7).	Trends in invasive alien species: Invasive Species Task Force established with Rapid Response Plans (for the five most serious invasive species threats after the Brown Tree Snake) developed for each state (2008).

Goals and Targets	Relevant indicators
Goal 7: Address challenges to biodiversity from climate change, and pollution.	
Global Target 7.1: Maintain and enhance resilience of the component of biodiversity to adapt to climate change. National Target: Mainstream environmental considerations, including climate change, into national policy and planning as well as in all economic development activities (FSM SDP – Env. Matrix SG1).	Connectivity/fragmentation of ecosystems: • Dalipebinaw School Forest Reserve protects from ridge to the reef. • Yela Conservation Area under progress to protect watershed-swamp-reef ecosystems. • Oroor Conservation Area under traditional management protects from ridge to reef. • Government and NGOs trained in conservation area planning methods. • National Sustainable Development Strategy Assessment completed in 2006. • Einpein Forest Reserve and Marine Protected Area cover multiple connected ecosystms. • Ahnd and Utwe Biosphere Reserves provide swamp-coastal-nearshore connectivity.
Global Target 7.2: Reduce pollution and its impact on biodvsty. National Target: All human-generated wastes are effectively managed to prevent or minimize environmental degradation, pollution and loss of the nation's biodiversity (NBSAP Theme 7).	• Nitrogen deposition – no data. • Water quality in aquatic ecosystems – Assessments show at least 8 main rivers unsafe for recreational use in Pohnpei, and there is no management; Kosrae has placed 13 major rivers under legal protection; Yaps' main aquatic ecosystem is protected (area unknown); aquatic systems in all states increasingly threatened due to human and animal pollution.
Goal 8: Maintain capacity of ecosystems to deliver goods and services and support livelihoods.	
Global Target 8.1: Capacity of ecosystems to deliver goods and services maintained. National Target: Manage and protect the nation's natural environment – protect, conserve and sustainably manage a full and functional representation of the FSM's marine, freshwater and terrestrial ecosystems (FSM SDP – Env. Matrix SG5).	• Biodiversity used in food and medicine – Ongoing project between FSM and NYBG noting traditionally used plants and uses; (see *Plants and People of Pohnpei…* by Balick et al.) • Water quality in aquatic ecosystems – (see 7.2 above); many rural communities depend on river systems as food source (snails, prawns, river eels, water for drinking and bathing, etc.) • Marine trophic index – no data • Incidence of human induced ecosystem failure – localized inshore fisheries sites collapsing due to overfishing; sea cucumbers, giant clams, trochus similarly collapsed due to overexploitation; some estuarine and lagoon areas collapsed due to heavy pollution.
Global Target 8.2: Biological resources that support sustainable livelihoods, local food security and health care, especially for poor people maintained. National Target: Traditional resource owners and communities are fully involved in the protection, conservation, preservation, and sustainable use of the nation's biodiversity (NBSAP Theme 9).	Health and well-being of communities who depend on local ecosystem goods and services: • Most rural communities outside of urbanized areas still thriving due to near climax function of upland ecosystems; there are health problems due to untreated water supplies. Biodiversity used in food and medicine: • Harvesting of flying fox for food is rare, maybe nonexistent; some illegal export occurs. • Harvesting of pigeons and other bird species is a continuing threat; possibly increasing. • Harvesting of plants for medicinal purposes is continuing use; most collected from the wild.

Goals and Targets	Relevant indicators
Goal 9: Maintain socio-cultural diversity of indigenous and local communities.	
Global Target 9.1: Protect traditional knowledge, innovation and practices. National Target: Traditional resource owners and communities are fully involved in the protection, conservation, preservation, and sustainable use of the nation's biodiversity (NBSAP Theme 9).	Status and trends of linguistic diversity and numbers of speakers of indigenous language: • Cultural diversity is reflected in the existence of seventeen indigenous languages: Yapese, Ulithian, Woleaian, Satawalese, Pohnpeian, Nukuoran, Kapingamarangi, Mokilese, Pingelapese, Ngatikese, Namonuito, Nguluwan, Paafang, Puluwatese, Chuukese, Mortlockese, and Kosraean; nearly all 110,000 people speak one or more of these indiginous languages; trend is toward decline as younger generations are taught only English by both school and parents and generations born in U.S. lose both custom and language.
Global Target 9.2: Protect the rights of indigenous and local communities over their traditional knowledge, innovations and practices, including the right to benefit sharing. National Target: Enhance the benefits of sustainable use of the FSM's genetic resources and ensure benefits derived are fairly shared amongst stakeholders (FSM SDP – Env. Matrix SG4).	• Appears that no legislation regulating bio-prospecting and intellectual property rights is yet in place; most reasearchers do follow appropriate protocols (see box 8.1 above). • Suggested research permitting process establishment through national government. • Suggested traditional knowledge database development using World Intellectual Property Organization's (WIPO) recommended protocol.
Goal 10: Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources.	
Global Target 10.1: All access to genetic resources is in line with the Convention on Biological Diversity and its relevant provisions. National Target: The FSM's genetic resources are accessible for utilization and all benefits derived are equitably shared amongst stakeholders (NBSAP Theme 3).	• Refer to 9.2 above; national government remains vigilant and alert to ensuring any profits or pecuniary gain from indigenous genetic material be appropriately shared with resource owners/communities/clans.
Global Target 10.2: Benefits arising from the commercial and other utilization of genetic resources shared in a fair and equitable way with the countries providing such resources in line with the Convention on Biological Diversity and its relevant provisions. National Target: Enhance the benefits of sustainable use of the FSM's genetic resources and ensure benefits derived are fairly shared amongst stakeholders (FSM SDP – Env. Matrix SG4).	• Refer to 9.2 and 10.1 above.

Goals and Targets	Relevant indicators
Goal 11: Parties have financial, human, scientific, technical and technological capacity to implement the convention.	
Global Target 11.1: New and additional financial resources are transferred to developing country Parties to allow for the effective implementation of their commitments under the Convention, in accordance with Article 20. National Targets: Local, regional and international financial sources provide for the long-term financial sustainability of all conservation and biodiversity related activities (NBSAP Theme 11). All citizens, residents and institutions of the nation are aware of the importance of biodiversity and have the technical knowledge, skills and capability to conserve, preserve and sustainably utilize, manage and develop all biodiversity within the nation (NBSAP Theme 8).	Official development assistance provided in support of the Convention: • US$1.5 - 2 million in Compact funds administered annually by Gov. agencies since 2004. • MCT working toward establishment of a $20 million endowment for conservation actions; MCT has contributed nearly $3 million from 2007-09 for implementation of NBSAP. • State Conservation NGOs (KCSO, CSP, CCS, YINS, YapCAP, IFCP, YELA, etc.) and CBOs also utilize approximately $3 million per year (FY2007) for implementation of Convention. • Other international donors include the UN, USFS, NOAA, Japan, the European Union, Germany, Italy, Australia, New Zealand, Turkey and other institutions and foundations. • Institutions such as TNC, SPREP, RARE and SPC provide annual technical assistance. • Youth-to-Youth environmental awareness program ongoing in schools. • Micronesians in Island Conservation network expanding across the region. • Micronesia Challenge (see note on MCT above) Strategic Plan completed. • Micronesia Challenge Young Champions Intern program ongoing.
Global Target 11.2: Technology is transferred to developing country Parties to allow for the effective implementation of their commitments under the Convention, in accordance with its Article 20, paragraph 4. National Targets: Reduce energy use and convert to renewable energy sources / Minimize emission of greenhouse gases (FSM SDP – Env. Matrix SG3). Economic development activities in the FSM meet the needs of the population while sustaining the resources for the benefit of future generations (NBSAP Theme 5). Enhance and employ in-country technical capacity to support environmental programs (FSM SDP – Env. Matrix SG9).	Technology transfer consists mainly of: • Trainings in off-grid and mini-grid PV-systems in '08 and '09 as part of the REP-5 Programme out of the EU EDF9; now have more than 10 EU-certified Solar Technicians. • Small RE demonstration projects (solar aircon unit, windmill, pico-hydro, etc.) in 2009 from the CEPP programme out of the EU EDF9. • Trainings conducted in communities throughout FSM on aquaculture techniques in farming sponges and other commercially viable marine products for local sale and export; also through the CEPP EU EDF9 programme. • MIC learning exchanges ongoing for effective conservation area planning and management techniques.

4.3 Progress towards the goals and objectives of the strategic plan

Strategic Goals and Objectives	Relevant indicators
Goal 1: The Convention is fulfilling its leadership role in international biodiversity issues.	
1.1 The Convention is setting the global biodiversity agenda.	• Convention, which the FSM ratified in 1994, is setting the global biodiversity agenda in the North Pacific through the seminal Micronesia Challenge. • Yes, Convention is promoting policy coherence in linkages to U.S. Compact, MDGs, and other major international instruments. • Other international processes supporting implementation of the Convention are the UNCCD, the UNCCC, Noumea Convention, the 1991 Espoo Convention, Stockholm Convention on POPs, US-FSM Soil and Water Conservation Agreement, Montreal Protocol and others.
1.2 The Convention is promoting cooperation between all relevant international instruments and processes to enhance policy coherence.	
1.3 Other international processes are actively supporting implementation of the Convention, in a manner consistent with their respective frameworks.	
1.4 The Cartagena Protocol on Biosafety is widely implemented.	Not enough data available to make a conclusive comment, however, LMOs, due to strict quarantine measaures at FSM ports of entry are likely not entering the country.
1.5 Biodiversity concerns are being integrated into relevant sectoral or cross-sectoral plans, programmes and policies at the regional and global levels.	• FSM SDP, IDP, MDGs, MC are all relevant national, regional and global sectoral plans, programs and policies in this case. • Environmental Impact Assessments are required for all major projects that have a bearing on cultural and/or environmental conditions; however EIAs are not always applied in the correct manner; this is a challenge that requires attention toward better application of EIAs. • All Asian Development Bank projects in FSM are required as a matter of policy to integrate environmental considerations.
1.6 Parties are collaborating at the regional and subregional levels to implement the Convention.	Micronesia Challenge is a sub-regional effort to implement Convention; Micronesia Conservation Trust is a regional funding mechanism for countries of the North Pacific to implement Convention; Micronesians in Island Conservation is a network of conservation leaders from the region working together to implement the Convention.
Goal 2: Parties have improved financial, human, scientific, technical, and technological capacity to implement the Convention.	
2.1 All Parties have adequate capacity for implementation of priority actions in national biodiversity strategy and action plans.	Capacity to plan for and implement conservation actions is enhanced, but ongoing training/education is still needed for CBOs, NGOs and government.

Strategic Goals and Objectives	Relevant indicators
2.2 Developing country Parties, in particular the least developed and the small island developing States amongst them, and other Parties with economies in transition, have sufficient resources available to implement the three objectives of the Convention.	• Objective 1: Conservation • Objective 2: Sustainable Use • Objective 3: Benefit Sharing of Genetic Resources Resource allocations for all three are satisfactory, but not optimal – more are needed for better implementation of the Convention objectives.
2.3 Developing country Parties, in particular the least developed and the small island developing States amongst them, and other Parties with economies in transition, have increased resources and technology transfer available to implement the Cartagena Protocol on Biosafety.	More effective implementation of the Protocol in accordance with the precautionary approach will require more resources and transfer of technology than currently is available.
2.4 All Parties have adequate capacity to implement the Cartagena Protocol on Biosafety.	Capacity needs to be enhanced for national quarantine officers to be able to effectively identify and handle LMOs.
2.5 Technical and scientific cooperation is making a significant contribution to building capacity.	Consistent with VII/30, yes, technical and scientific cooperation is contributing to capacity building.
Goal 3: National biodiversity strategies and action plans and the integration of biodiversity concerns into relevant sectors serve as an effective framework for the implementation of the objectives of the Convention.	
3.1 Every Party has effective national strategies, plans and programmes in place to provide a national framework for implementing the three objectives of the Convention and to set clear national priorities.	FSM has effective national strategies in place; these mainly inlcude the NBSAP, the State BSAPs, the EDF9 and EDF10 Programmes of Work, the MDG National Report (under development), the SDP, the MC, and the FSM PAN.
3.2 Every Party to the Cartagena Protocol on Biosafety has a regulatory framework in place and functioning to implement the Protocol.	There is a regulatory framework in place as to standard national quarantine protocols, which should apply to the Cartagena Protocol as well in terms of practical application; further training on identification of LMOs may be required.
3.3 Biodiversity concerns are being integrated into relevant national sectoral and cross-sectoral plans, programmes and policies.	FSM has integrated its NBSAP into its 20-year national Strategic Development Plan; cross-sectoral consideration of full socio-eco-enviro themes is something that is an ongoing process.
3.4 The priorities in national biodiversity strategies and action plans are being actively implemented, as a means to achieve national implementation of the Convention, and as a significant contribution towards the global biodiversity agenda.	Many of the key priorities of the FSM NBSAP are being actively implemented (e.g., conservation area planning and implementation, financing), while certain component actions still require a more concerted effort (e.g., aeriel surveys, ecosystem assessments, EIA training, rehabilitation, policy regarding deleterious fishing practices).
Goal 4: There is a better understanding of the importance of biodiversity and of the Convention, and this has led to broader engagement across society in implementation.	
4.1 All Parties are implementing a communication, education, and public awareness strategy and promoting public participation in support of the Convention.	• States are primarily responsible for educational activities within the schools; and it is largely the conservation NGOs in FSM that are leading this

Strategic Goals and Objectives	Relevant indicators
	effort (CSP has an excellent ongoing school program, for example, that produces workbooks for children); additionally, both NGOs and state resource agencies (e.g., EPAs) implement broader environmental awareness campaigns annually (e.g., mangroves, crabs, watersheds). • Percentage of public awareness programmes/projects about the importance of biodiversity • Percentage of Parties with biodiversity on their public school curricula
4.2 Every Party to the Cartagena Protocol on Biosafety is promoting and facilitating public awareness, education and participation in support of the Protocol.	This has not as yet been undertaken in FSM. More resources for a campaign are required, as well as additional training for quarantine personnel.
4.3 Indigenous and local communities are effectively involved in implementation and in the processes of the Convention, at national, regional and international levels.	Local communities are still not involved as well as they could be; however it has improved considerably through the Convention process; national and state governments – along with NGOs – will need to continue to improve this effort.
4.4 Key actors and stakeholders, including the private sector, are engaged in partnership to implement the Convention and are integrating biodiversity concerns into their relevant sectoral and cross-sectoral plans, programmes and policies.	The NBSAP – and the SDP Environment Strategy – likely need to be revisted, assessed as to progress, and updated, as per the five-year review outlined in both the SDP and NBSAP; private sector needs to be brought to the table so that biodiversity concerns become a bigger part of doing business in FSM; currently economic growth appears to be a priority over integrity of ecosystems.

4.4 Conclusions

4.4.1 Overall assessment

The implementation of the Convention on Biological Diversity through the NBSAP has been a major catalyst to the conservation of biodiversity in the FSM. In a place where people live amidst and have relied directly upon the climax function of ecosystems for survival for many generations, it can be said that the Convention is a modern means by which to put back into equilibrium a society that is becoming daily removed from a traditional way of life. Modernity is to be expected of course, and perhaps even encouraged in essential matters of society; the ecology of place should be equally expected, and respected as a prominent partner at the table of progress. In the three main objectives of the CBD - conservation of biodiversity, sustainable use of

resources, and access to and benefit sharing – a considerable amount of progress has been made since the beginning of the last decade. The conservation of biodiversity through modern and traditional means has become a priority at many levels, from local governments to communities. Since 2002, more than five upland forests have been placed under protection, more than 15 new marine protected areas have been established, and the designation of two UNESCO Biosphere Reserves has occurred, all with NGOs and communities central to the process. Perhaps the greatest example of this can be seen in the effort currently being made by the Yela Environment Landowners Authority (YELA), a grouping of 13 families who have chosen to set aside their ancestral lands – one of the few remaining roadless areas in the FSM – for the purpose of conserving one of the 24 Priority Areas of Biodiversity Significance identified in the federation. It is truly a groundbreaking community-led effort with a host of heavy precedents associated with it as the conservation work proceeds[119]. Paradoxically (or not), the YELA group most often finds itself pitted against both the state and national government in their respective mandates to obligate funds for infrastructure – in this case a road that would potentially destroy the integrated ecologies of the area – and the need to "climate proof" such infrastructure. YELA feels that the best way to climate proof a forest – i.e., ensure its climax function to provide ecosystem services – is with a forest. This is but one example that highlights the broader challenges that the nation faces today. The FSM of course has a strong environmental ethic that runs through its history anyway, and exists to some degree today, but it has become more fragmented under the pressure of a type of development that is often blind to the common ecological sensibility of the past. The instruments, machinery, speed and resources dedicated to development are still much greater than those applied to maintaining the ecological status quo. The Convention is therefore an excellent framework, a tool perhaps, by which to ensure some balance does exist in the pursuit of progress.

As for the sustainable use of resources, the national government, and in particularly the Department of Resources and Development, has been an instrumental stakeholder in helping to promote this objective. Conservation after all, is ultimately a means by which to benefit the human inhabitants of particular ecosystems; conservation is the means to the end of sustainable use. And in FSM, as elsewhere, when we talk about sustainable use, we are talking about community and rural livelihoods. It has been recognized in the FSM in its assessment on sustainable development commissioned by the Department of Economic Affairs (2006) that it is crucially important to sustain ecosystems over time if a true and broad economic and social well-being is to be attained. This means creating jobs and income around not only conservation initiatives – what one might call "greening" the economy – but also using biodiversity over time to create revenue streams into the macroeconomy. An excellent example here can be seen in the public-private partnership that is working toward an eventual privatization of a national aquaculture facility in Kosrae. The facility – one of the premiere such facilities in the tropics – is designed for raising giant clams, and has now started replicating and growing

[119] Conservation easements, a tactic used in other developed parts of the world by The Nature Conservancy to ensure broadscale, long-term conservation of primary ecosystems, is for the first time going to be trialed anwhere in the Pacific with the Yela Conservation Area.

certain hard and soft corals for export, mostly to the aquarium enthusiast markets on the west coast of the U.S. and western Europe. This operation, now known as Micronesia Marketing and Management Enterprises, employs a minimum of five full-time staff and is now not only bringing in desperately needed cash into the economy, but it is also now expanding into the communities, where selected fishermen and farmers are assisting the production of both coral and clams in in-situ grow-out sites on the reefs. Under the arrangement, 10% of all corals and clams that are raised are placed back into the wild. This is an example of sustainable use that is both good for the economy and good for the environment. The project is still not fully realized – can aquarium fish be exported sustainably; can it be done without taking away one of the resources that the eco-tourism operators rely upon; can they be successfully aquacultured in captivity? – but these are the sorts of subsidies and eco-friendly industries that equatorial Pacific Island countries like the FSM are trying to support in trying to achieve the aims of the Convention.

On genetic resource use and benefit sharing, this is quite litterally a fledgling concept both in idea and practice in the FSM, and as such, it has perhaps not progressed as quickly as the other primary objectives of the Convention. However, with the richness and endemism of the plant species in the FSM, this objective is as relevant as any of the others. It is good that it has been integrated into the national strategic policy framework of the country, which alligns well with traditional and customary practices of intellectual property rights in any case[120]. One tangindental case can be seen from the ongoing FSM-New York Botanical Garden studies into traditional ethnobotany on the high islands of the FSM[121]. Here, Dr. Michael Balick, Director of the Institute of Economic Botany at the New York Botanical Garden, and his colleagues documented a species of cinnamon (*Cinnamomum carolinense*), known locally as *Madeu*, that is found only on Pohnpei, and is commonly used by the islanders to drink tea made from the tree's bark to relieve pain. Curiously, the bark of the Pohnpei cinnamon species contains high amounts of the carcinogenic compound safrole – the same substance found in sassafras bark, which prevents the herb from being sold for herbal tea in the United States. Balick and his research team were puzzled by the fact that Pohnpeians did not develop cancer from drinking the cinnamon bark tea. Following chemical analysis of the bark, they tested the chemistry of the tea. Balick and his colleagues found that the heat of the tea removed the harmful chemical from the cinnamon. He said this optimal way of preparing this natural pain reliever had likely been discovered by island natives after generations of trial and error. It has been expressly stated that all such medicinal processes – and of course the genetic material itself – belong to the people and the *Mwoalen Wahu Ileilehn Pohnpei* (Pohnpei Council of Traditional Leaders).

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[120] It is customary for certain clans, families and individuals to possess specific knowledge and skill in how to select, prepare and apply certain plants and concoctions to say, relieve pain, treat fever, birth a child, heal bones and skin, etc., and these are often treated, in the traditional norm, as what the Convention refers to as Intellectual Property Rights.

[121] Once again, the superlative *Ethnobotany of Pohnpei: Plants, People & Island Culture*, by Michael Balick and Collaborators, is a phenominal resource and an excellent addition to the cannon of environmental/cultural work on FSM; it should be read by anyone interested in islanders and their relationship to nature, and in particular, what is termed the ethnomedicine system.

One of the most common refrains in the FSM – as common as the white sand beaches, the prolific rain forests and the crystal blue reefs – is that there are not nearly as many fish as there used to be; it's just not as good as it was in the old days *when*…Such anecdotal tales surely have merit; even in the last ten years, certain areas of reef in the FSM that are being fished show a decline in species diversity as well as number. Rapid Ecological Assessments and Fish Market Surveys carried out throughout the FSM between 2005 and 2007 support such sentiment: current harvest practices and amounts simply do not provide a picture of sustainability. The reefs and associated nearshore ecosystems – seagrass beds, mangroves, brackish channels and lakes – are the collective bread basket of the FSM. These systems litterally produce tens of millions of pounds of commercially and culturally important food, which is the foundation of the healthy, local diet. A study conducted in 2006 over a four-month period in a representative rural community in FSM revealed that it consumed 127 different species of fish (see **Table 12** in **Chapter 1**) over that time span. Some semblance of balance must be restored if biodiversity levels are to be maintained, let alone reversed. The Convention has thus been in play at the appropriate time, not coincidentally, guiding policy makers, NGOs and communities in working toward sustainability. Indeed, the FSM has made an ambitious commitment through the Micronesia Challenge – with the NGOs at the lead with the governments of the region – and community participation and buy-in is still essential moving forward if these aims are to be effectively achieved.

On a final and important point here, although problems loom in terms of increasing pollution of all forms – air, noise, water, land – as raw sewage is dumped into bays, estuaries, lagoons and channel passes, as pig and other effluent is dumped into wetlands and rivers, diesel power plants spew noise and smoke into the air, and solid waste is dumped into cleared out patches of mangrove, there are solutions on the horizon. Cross-sectoral issues such as waste management, renewable energy and climate change adaptation that have strong biodiversity conservation links have been instigated. Currently, there are official national Policies for all three areas and they are beginning to be integrated broadly. These are positive developments in the continuing national effort toward implementation of the Convention and the 2010 Target.

4.4.2 Lessons learned during implementation

Protect biodiversity by protecting livelihoods

The community based approach to the conservation and sustainable use of resources over customary owned lands was pioneered before the NBSAP through other initiatives. NBSAP implementation built on it, and together with other practitioners, found several lessons. One is related to links between conservation and income generating activities. In brief, protecting biodiversity by protecting livelihoods and ensuring adequate government support toward basic services will ensure sustained community commitment and support. Ignoring this will result in waning commitments to conservation objectives as local communities focus their energies and resources on their immediate priority – livelihoods.

Information needs are a priority

Having up-to-date information is essential and priority should be given to resource and ecosystem assessments, species surveys, and the like. Both aerial surveys and GIS ground-truthing in forests in particular would cerainly be of much help for the FSM. They are the basis for the reviewing of conservation priorities, particularly in the case of endangered species and ecosystems, so that limited conservation funds are allocated to where the greatest biodiversity threats are. There are also areas such as freshwater biodiversity, of which little is known, or perhaps better stated, assessed for the official record.

Using all available capacity – especially from the Conservation NGOs

It is vital to engage all players, including NGOs and private sector operators, in NBSAP implementation. The private sector is often – perhaps unwittingly – the greatest threat to biodiversity. Though there does exist improved technical expertise and capacity within government agencies, they can often be overworked, and the conservation NGOs have been particularly successful in their specific areas of work. Local NGOs are increasingly playing active/essential roles in nature conservation. There is a greater acceptance for collaboration from both Government agencies and particularly within local communities.

NBSAP monitoring using proper targets and indicators

In the absence of any NBSAP monitoring process – outside of some reference to it in different national reports and assessments - since the NBSAP was approved, it is somewhat difficult to properly assess progress in NBSAP implementation. After nine years of implementation, a review is overdue. The NBSAP needs strengthening in several areas, including having a monitoring plan with well thought through monitoring targets and indicators. Several relevant studies and programs are in progress that will generate relevant information with which to review of the statuses of priority species, taxonomic groups and ecological sites. This Fourth National Report has also been an excellent excersize in this regard.

Mainstreaming biodiversity

Ensuring the further strengthening of the environmental ethic throughout society requires that a broad cross-section of institutions, disciplines and individuals be part of national planning and implementation processes, including municipal and community stakeholders. Top leaders and thinkers in the fields of economics, sociology, history, culture and ecology – to name a few essential areas – should be involved with decision making and the integration of the ecological mindset into each sector and level, so as to minimize the opportunities of us vs. them mentalities, or environmentalists versus economists, for example. It is also important for municipal, traditional and community leaders to be invited as a regular part of the process in order to achieve the results where they are actually seen and felt: at the grass-roots level.

NBSAP implementation council

As has been recommended in several previous, analysis' and assessment reports, the President's SD Council should likely be deputized with more authority and stronger mandates, integrating some of the previous lessons learned discussed above. One of its priorities would be implementation of the Convention.

4.4.3 Summary of future priorities

The following are some immediate priorities for the future:

- A cross-sectoral review of the 2002 NBSAP including the development and implementation of a Monitoring Plan.
- Addressing key gaps in information:
  - Freshwater fauna
  - Invertebrates
  - Threatened plants
  - Update on the status of priority ecological sites
  - Updated aerial photography and other methods to determine native forest cover
  - Update on the status of vulnerable, endangered and critically endangered species including several bird species, all of the fruit bat populations and the Caroline sheath-tailed bat.
  - Status of all introduced species of agriculture, marine and freshwater fauna including an assessment of abundance and distribution.
- Training for relevant government personnel, and those within other relevant agencies, institutions and NGOs in a number of areas including, techniques and methods of natural resource assessments and species surveys, biodiversity valuation methods, environmental impact assessments, the integrated ecosystem approach, and others.
- Update of the biodiversity clearinghouse mechanism as a repository of information, including relevant reports and published scientific papers of completed studies.
- Taking/Continuing with a strategic approach to expanding the protected area system – to improve 'representativeness' of all ecosystems including sites of high priority, and promoting ecological connectivity and corridors.
- Pushing for and supporting international bans on destructive and illegal fishing practices for key migratory species on the high seas (e.g., turtles, sharks, and tuna).
- Continue to allocate public and private resources toward Convention goals, including the fullest support to the Micronesia Conservation Trust.

Appendix I

Information concerning reporting party and preparation of national report

A. Reporting Party

Contracting Party	**FSM National Government**
NATIONAL FOCAL POINT	
Full name of the institution	**FSM Department of Resources & Development**
Name and title of contact officer	**Mr. Marion Henry, Acting Secretary**
Mailing address	**PO Box PS-12, Palikir, Pohnpei, FM 96941**
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E-mail	**marionh@mail.fm**
Signature	
CONTACT OFFICER FOR NATIONAL REPORT (IF DIFFERENT FROM ABOVE)	
Full name of the institution	**(Same as above)**
Name and title of contact officer	
Mailing address	
Telephone	
Fax	
E-mail	
Signature	
SUBMISSION	
Signature of officer responsible for submitting national report	**Mr. Marion Henry, Acting Secretary, FSM DoR&D**
Date of submission	**March 2010**
Signature	

B. Process of preparation of national report

A National Consultant was contracted by the Government of FSM to compile the draft report.

The following process was followed:

I. Commission of consultancy – briefing on terms of reference, CBD Guidelines for the Fourth National Report; clarification of process.

II. Identification of National Coordination Team (NCT) and key State Focal Points.

III. Initial NCT meeting to review Fourth National Report Outline and guidance on way forward.

IV. Collation of relevant reports with the assistance of DoR&D and associated national government offices, agencies and departments.

V. Desk study reviewing available reports.

VI. Face-to-face consultations with representatives of key agencies, discussing issues and seeking all relevant information.

VII. Fourth National Report presentation and consultative workshops coordinated by state focal points and attended by other key cross-cutting agencies (government, NGOs, private sector, etc.) at the state level.

VIII. Preparation of draft report.

IX. Transmittal of draft report to NCT and other stakeholders/experts for review.

X. Consultative meeting with the NCT for presentation of draft report and for comments.

XI. Incorporation of comments from consultative meetings and other communications.

XII. Finalization of Report and submission to DoR&D.

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Appendix III

Progress towards targets of the global strategy for plant conservation and programme of work on protected areas

Target	Title	National actions Taken
Target 1	A widely accessible working list of known plant species, as a step towards a complete world flora	FSM's list of known terrestrial plants is accessible through the Clearninghouse Mechanism established with COM-FSM and is continually being added to with additional findings. Information on freshwater flora is lacking.
Target 2	A preliminary assessment of the conservation status of all known plant species, at national, regional and international levels	An assessment of selected species of known plants has been done but this is mainly limited to plants and trees of economic and cultural importance. For instance, indigenous forest hardwoods species of importance and local medicinal plants have been partially assessed.
Target 3	Development of models with protocols for plant conservation and sustainable use, based on research and practical experience	No official government model has been established; however, the ongoing collaborative effort with the NYBG, which has resulted in the recent publication of *Ethnobotany of Pohnpei*, has set a clear and effective precedent.
Target 4	At least 10 per cent of each of the world's ecological regions effectively conserved	National target of 20% of total land area protected by 2020 (Micronesia Challenge); about 10% achieved to date.
Target 5	Protection of 50 per cent of the most important areas for plant diversity assured	Seven of the 24 ABS Priority Action Areas (PAAs) are under conservation management. The Micronesian Conservation Trust is continuing to focus primarily on covering a greater percentage of the PAAs each year.
Target 6	At least 30 per cent of production lands managed consistent with the conservation of plant diversity	No relevant information to report.
Target 7	60 per cent of the world's threatened species conserved in situ	11 bird and 4 bat species are critically endangered, with 1 endemic bird species possibly extinct, along with 3 turtle and 3 plant species on the IUCN Redlist. All are conserved (or attempted) in situ to varying degrees. Many other endemic species and sub-species not considered threatened are thriving in situ.
Target 8	60 per cent of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programmes	No inventory has been conducted on threatened plants within botanical gardens, reserves and protected areas.

Target 9	70 per cent of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated indigenous and local knowledge maintained	Insufficient information to report on progress; in terms of Traditional Environmental Knowledge, progress has been made in reference to the publication, *Ethnobotany of Pohnpei*, which documents traditional medicinal and other uses of plants.
Target 10	Management plans in place for at least 100 major alien species that threaten plants, plant communities and associated habitats and ecosystems	The National Invasive Species Action Plan being carried out by each of the State ISTs target the major invasive alien species of priority in FSM.
Target 11	No species of wild flora endangered by international trade	No progress to report; export of wild corals remains illegal.
Target 12	30 percent of plant-based products derived from sources that are sustainably managed	Primary export in FSM is in the form of mangrove trees used for carving handicrafts; but not enough information to report on whether there is progress in terms of sustainable management.
Target 13	The decline of plant resources, and associated indigenous and local knowledge innovations and practices that support sustainable livelihoods, local food security and health care, halted.	No progress to report; it is estimated, despite ongoing programs and efforts, that decline continues.
Target 14	The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes.	Plant diversity and the need for conservation has been successfully incorporated in communication, education and public awareness programmes; this effort is ongoing.
Target 15	The number of trained people working with appropriate facilities in plant conservation increased, according to national needs, to achieve the targets of this Strategy	More people/staff are getting trained in plant and biodiversity conservation each year as more opportunities become available and the importance and value is recognized; more are required to meet the need.
Target 16	Networks for plant conservation activities established or strengthened at national, regional and international levels	FSM PAN and PIMPAC/LMMA at national level; Micronesians in Island Conservation at the regional level; Micronesia Challenge (Regional Office and Steering Committee) at the international level.