TERRESTRIAL BIODIVERSITY OF THE FEDERATED STATES OF MICRONESIA

Report prepared
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FSM National Biodiversity Strategy and Action Plan Project

February 2002

The FSM National Biodiversity Strategy and Action Plan Project is funded by the Global Environmental Facility, implemented by the United Nations Development Programme and nationally executed by the FSM Department of Economic Affairs

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Executive Summary

The diversity of terrestrial plants and animals within the FSM varies from east to west due to differences in climate (particularly rainfall), geology, topography and geographical isolation. Major vegetation types in the FSM are: cloud forest, native upland forest, palm forest, agroforest, secondary vegetation, savanna grass and fern lands, freshwater marsh, swamp forest, mangroves, atoll forest, limestone forest of rocky coasts and beach strand. The area covered by each vegetation type varies between the states and some types may not occur. For example, cloud forest is restricted to the cloud shrouded mountainous peaks of Pohnpei and Kosrae, which are absent in Chuuk and Yap. Upland forest and agroforest are the major vegetation types in all states, but the area of relatively intact native forest is very limited in Chuuk and Yap. Native forests are being heavily impacted throughout the FSM but vegetation maps based on 1976 aerial photos have been updated only for Pohnpei. Updated vegetation maps are needed to access changes since previous surveys for the rest of the FSM.

The terrestrial biodiversity of the FSM has not been thoroughly documented as survey work has been limited and existing literature is scattered. Thus only a preliminary sketch on vascular plants and vertebrates is possible. The inventory and monitoring of the biodiversity of the FSM is integral to a thorough understanding and appreciation of the islands biodiversity and should be included in the FSM National Biodiversity Strategy and Action Plan. Over 1239 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. Each state of the FSM has its own outstanding features and biodiversity treasures. Kosrae has magnificent swamp forests dominated by endemic *Terminalia carolinensis* and *Horsfieldia nunu* trees. Pohnpei has the most endemic species in the FSM, Chuuk is also high in endemics and has some of the most endangered native forests in the FSM. Yap has the most diverse mangroves and agroforests in the FSM. Over 457 species of plants, including many food plants have been introduced to the FSM. 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.

Native terrestrial mammals of the FSM include five endemic species and subspecies of fruit bats of the genus *Pteropus* and a sheath-tailed bat of the genus *Emballonura*. Taxonomic and biological studies of the FSM's bats are not complete. Introduced mammals include 3 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.

One hundred and nineteen species of birds have been reported in the FSM. These include 31 resident seabirds, 33 migratory shorebirds, 19 migratory land or wetland birds and 5 vagrant species (Engbring et al.1990). Each State of the FSM has one or more endemic species. They include the Dusky White-eye of Kosrae and Pohnpei, Pohnpei Lory,

Pohnpei Greater White-eye, Pohnpei Flycatcher, Pohnpei Mountain Starling, Pohnpei and Chuuk ground dove, Truk greater white-eye, Oceanic flycatcher, Yap Monarch and Yap Greater white-eye. A number of the FSM's birds have become extinct or are declining in numbers.

The least understood group of vertebrates in the FSM are the reptiles and amphibians. There is one introduced amphibian (*Bufo marinus*), and over 27 species of reptiles, most of them native and at least 2 endemic. Several species of lizards have been introduced but thus far, there have been no confirmed introductions of the brown tree snake, which has decimated bird and reptile populations on nearby Guam. While there has been some work done on the terrestrial invertebrates of the FSM, reports are scattered, and mostly located outside of the FSM so that a review of FSM's invertebrates is beyond the scope of this preliminary report. There are indications however that the invertebrate fauna of the FSM is also rich and interesting. Recent collections in Pohnpei for example have yielded numerous species of land snails, and 50 species of ants.

Due to the sparse knowledge of FSM's biodiversity, an up to date list of threatened "species in peril" has not been compiled at national or state levels. Some species present in the FSM are, however, included in the IUCN Red List of threatened species as well as appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the U.S. Endangered Species Act listing of Threatened and Endangered species. The Endangered Species Act of the FSM was carried over from the Trust Territory of the Pacific Islands and is incomplete. As part of its biodiversity program, the FSM should take steps to inventory the status of its biodiversity and to identify FSM species in peril. As this will, of necessity, take some time, it is important to take immediate action to identify and maintain important and critical areas of native habitat so that species will not be lost. Threatened terrestrial native habitat of the FSM includes cloud forest, remaining areas of native forest, native fresh water marsh and riverine systems, swamp forest, and critical areas of mangrove forest and uninhabited atoll seabird and turtle rookeries. Other critical areas such as sea bird roosting and nesting sites, sea turtle rookeries, coconut crab islets and fruit bat roosting sites should also be protected.

It is clear that more information is needed on the biodiversity of the FSM. An even more immediate need is the development of a context within the FSM for the gathering and use of such information. Depositories of information on biodiversity are needed in each state and there is great need to develop local capacity for biodiversity work. A functional framework is needed to coordinate government programs, develop partnerships with local NGOs and communities and manage the resources of outside agencies and institutions so that the development of local capacity can go hand in hand with the gathering of information on the FSMs biodiversity. The development of means to support biodiversity professionals must also go hand in hand with their development. This will require both an immediate initial investment from U.S. and international sources of support for biodiversity work as well as a long-term mechanism for sustained support. These two mechanisms are potentially at hand through the environment sector of the renegotiated Compact and the Micronesian Conservation Trust respectively. While work

is progressing to develop an adequate support base, local capacity and a data base on biodiversity, it is essential that we also begin defining habitat and species in need of protection and enhanced stewardship as well as the Public awareness that will be required to care for and sustain the FSM's natural heritage. The FSM must find ways to make economic development ecologically sustainable. A set of indicators of sustainable development and a system for monitoring these indicators should be developed and incorporated into State and National development plans and programs. Given the natural heritage of the FSM and the ecological crises facing the world, becoming expert at sustainable livelihoods is a necessity that could become the role of the FSM among the nations of the world.

It should be noted that any statements of opinion and recommendations of this report are primarily those of the author and do not necessarily reflect the position of the NBSAP Project or the FSM Government.

1 Background

Biodiversity, or Biological Diversity refers to the great variety of living things on Earth. It includes all life, from microscopic living things to the great whales of our waters. The biodiversity of the FSM is our living wealth.

There are millions of species on Earth but only a small fraction of these species have been identified. Many of the species that have not been described are micro-organisms or groups that most people do not focus on such as the great variety of insects. In order to talk about the different kinds of living things, we have a variety of categories to that refer to living things. A species is a particular kind of living thing, like a coconut tree. Species are grouped into bigger categories like genera, families, orders, classes, phyla and kingdoms. When scientists refer to a particular kind of living thing, they use a two part name including the genus and the species. Thus the name for the coconut tree is *Cocos nucifera.* Scientific names are always underlined or italicized. There are also smaller categories like subspecies and varieties. This classification system allows us to talk about a specific kind of living thing or a more general group of living things, such as insects in general, or about varieties of a specific species such as the different varieties of *Colocasia esculenta* taro. It took many years to develop the many varieties of traditional Micronesian food crops, and they are a valuable heritage. It took much more time for unique species to develop. Some of these species, referred to as endemics, are found on only one or only a few islands, and they are an extra special heritage of each island of the FSM.

1.1 Why should we be interested in biodiversity?

All species are interconnected and important in an island's ecological system and our economies, cultures and very lives depend on this system. To maintain the health of an island ecosystem we need to assure that species are not lost. We have to be especially careful on islands because islands are small isolated places where species are present in smaller numbers, and are more easily lost. 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.

2 Natural Communities of Micronesia

Living things need suitable places (habitat) to live. Many live in natural communities like forests and mangroves. The natural communities of islands are integrated with one another into an island ecological system. Impacts on one community affect other communities. If we want our islands to be healthy and productive we need to assure that

the natural communities are intact and interlinked into an overall functioning system. The types of natural communities found on islands are related to gradients in environmental conditions such as rainfall, temperature, elevation, soil type, island size and isolation and patterns of winds, tides, storms as well as human impacts such as fires and clearing.

These environmental factors vary throughout the FSM. Rainfall for example, is higher and more evenly distributed throughout the year in eastern Micronesia especially on the high islands of Pohnpei and Kosrae. In contrast, the western part of Yap State lies within an area with a monsoon climate and has more distinct wet and dry seasons. Yap is unique in the FSM in having metamorphic rock and associated soils resulting from uplift of the ocean floor (plate tectonics), as well as old volcanic soils. Islands to the east are younger and are made up of limestone (atolls) and on Pohnpei and Kosrae, basaltic rocks and associated soils. Larger islands can accommodate more species, and high islands like Pohnpei and Kosrae have different environmental conditions with elevation. Atolls have limited variation in habitats but are of different sizes and lie in different rainfall regimes. Yap is closer to Southeast Asia and New Guinea, while the islands of eastern FSM are more isolated from large landmasses that serve as sources of flora and fauna. The people of the FSM have also greatly influenced island ecologies. Most Micronesian islands supported a dense population in the past and this resulted in heavy impacts on the islands flora and fauna. More recent impacts from heavy equipment, increased travel, introduction of weedy and invasive species, wildfires and other modern impacts have greatly affected natural communities and biodiversity of the FSM. We do not have records of these changes as natural resource and biodiversity monitoring programs have not been in place. We must implement inventories and monitoring of biodiversity as part of our NBSAP program so that we will not damage our heritage of natural systems and biodiversity without even realizing what we are doing.

Some of the natural communities found in the FSM include the following types arranged roughly from mountainous island interiors out to coastal mangroves or sandy beaches: Cloud forest, upland forest, palm forest, secondary forest, areas dominated by *Merremia* vines, agroforest, savannas, thickets of introduced trees, cultivated areas, freshwater marsh, swamp forest, *Nypa* swamp, mangroves, atoll forest, limestone forest of rocky coasts and beach strand. These types are briefly described in the next section. While all of these natural communities are found within the FSM, not every island has all of the types.

2.1 Major Vegetation Types in the FSM

2.1.1 Cloud forest

Within the FSM, only Pohnpei and Kosrae are high enough to have cloud forests. These dwarf moist forests of stunted trees covered with mosses, ferns, fern allies and orchids, are generally shrouded in clouds. Most of the species found in these special areas are native and many are endemic. Cloud forests are one of the most special habitats in the FSM.

2.1.2 Native Upland forest

The 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. There have not been enough studies of our native forests to define the types of native forests that occur. 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. As we learn more about the native forests of the FSM, we will recognize native forest associations.

2.1.3 Palm forest

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* (kochop) is common and there are two species of *Ptychosperma*: *P. hosinoi* and *P. ledermanniana* (kattai); the latter of which is also found on Kosrae. Small patches of the ivory nut, *Metroxylon amicarum* occur in wet locations on Pohnpei, Chuuk and can also be found in Kosrae. 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.

2.1.4 Agroforest

When the vegetation of the FSM was mapped, a type of forest was found that could not be typed 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. This was probably the first time that the U.S. Forest Service mapped this forest type.

Scattered coconut trees and breadfruit trees are indicators of agroforests, and some wild species may be present. The type varies throughout Micronesia. In Pohnpei it depicts areas from early to late stages of shifting agriculture, as well as settled 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.

2.1.5 Secondary Vegetation

This type is somewhat intermediate between forest and nonforest. Such areas are dominated by fast growing and weedy species that grow up in disturbed areas. Hibiscus and bamboo are common secondary vegetation species throughout the FSM. 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 are the large areas throughout the FSM and especially in Pohnpei that are dominated by *Merremia* vines.

2.1.6 Savanna Grass and Fern Lands

This type consists of land with low vegetation. Shrubs and trees, if present, are widely scattered. The soils are generally infertile and poorly drained clays. Savanna grass and fern lands are thought to be the result of destruction of the forest, particularly by fire, loss of the humus layer, and exposure of the soil to rain and sun. Frequent fires prevent tree species from growing, and the area remains without a forest canopy. In Pohnpei and Kosrae these open areas are generally indicative of disturbance and are filled largely with *Ischaemum* grass or *Gleichenia* ferns. 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.

2.1.7 Freshwater marsh and riverine systems

Marshes are filled with grasses, sedges and herbs growing in standing water most of the year. They are generally located in areas slightly above sea level and are often just inland of mangroves. 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. Riverine systems are isolated areas within islands and areas where unique species may possibly be found. They are also very important in freshwater and nutrient regimes.

2.1.8 Swamp forest

Swamp forests occur where soils are inundated with fresh or slightly saline water. They are most commonly found just inland of mangroves, above tidal influence but lower in elevation than the surrounding terrain. Other sites exist inland where water collects in low areas along rivers and in areas of impeded drainage. A number of subtypes exist such as thickets of *Hibiscus tiliaceus* and the ivory nut palm, *Metroxolon amicarum,* grows in swampy areas as well. A more diverse set of swamp species occurs in Yap, where however, the type has been mostly replaced by taro patches. The most magnificent swamp forests in the FSM are the tall *Terminalia* forests of Kosrae.

2.1.9 Mangroves

The most distinctive forest type in the FSM is mangrove. These forests have specialized roots inundated at least periodically by seawater. 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. The distribution of the main species of mangrove trees going from east to west in the FSM is shown in Table1 below:

Table 1. Species of main mangrove trees in the FSM

Species of main mangrove trees	Kosrae	Pohnpei	Chuuk	Yap
Avicennia alba				**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	**10**	**10**	**10**	**15**

Note: This table shows only main mangrove trees and does not include other species associated with mangroves. The listing of 4 species of *Rhizophora* is based on the recent surveys of Dr. Norm Duke.

2.1.10 Atoll forest

Atoll forests consist of a characteristic set of species that occur in the interior of the FSM's low atolls. This type is not included in table 1 and Figure 1 below, which are limited to the vegetation of high islands that is over a hectare in area.

2.1.11 Limestone forest of rocky coasts

This vegetation type, which is more common in the Marianas and Palau, occurs on the raised limestone island of Fais and has not been described.

2.1.12 Beach strand

This vegetation type consists of a characteristic set of species occurring along sandy beaches throughout Micronesia. In general it was too narrow to map and is not included in Table 1 or Figure 1 below.

2.2 Areas of major vegetation types in the FSM

Some of the general vegetation types found in the high islands of the FSM have been mapped (Falanruw et al. 1987a&b, MacLean et al. 1987, Whitesell et al. 1986). The maps were based on photo interpretation of black and white aerial photographs taken at a scale of 1:10,000 about 1976. Vegetation types were limited to those that could be discerned on the aerial photos with limited ground truthing. They included a series of main types with finer demarcations based on tree size, canopy, and in some cases, major species. Types that were under 1 hectare in area or difficult to discern using photo interpretation were not included. The distribution of major types, based on these data is given in Table 2, which includes some updates based on surveys made in 1983 for Kosrae and Pohnpei.

Table 2. General vegetation types of FSM high islands (in hectares) (adapted from Falanruw et al 1987a&b, MacLean et al 1987 and Whitesell et al 1986)

	Kosrae	Pohnpei	Chuuk*	Yap
Year	1983	1983	1976	1976
Mangrove	1,562	5,525	306	1,171
Swamp Forest	345	214		155
Upland Forest	5,090	12,548	677	2,556
Palm Forest		1,383		
Agroforest ***	2,585	11,865	2,378	2,538
Secondary vegetation	1,272	1,843	252	553
Grasslands		1,476	174	2,175
Marsh		149	234	165
Other nonforest **	263	490	149	403
Total Area	11,186	35,493	4,170	9,716

* In Chuuk State, only the islands of Moen, Dublon, Fefan & Eten were included in the survey because of the lack of aerial photographs of other islands of Chuuk Lagoon

** Other = inland water, urban, nonforest and types totaling less than 100 hectares in area

*** includes coconut plantations

Figure 1, which follows, is based on the data in Table 2 and shows the percentage of major vegetation types on the high islands of each of the FSM states. Vegetation types less than 1% are omitted from these graphs. These graphs show some of the differences in the vegetation of the high islands of the FSM. For example, Kosrae and Pohnpei have a greater percentage of forest than Chuuk and Yap, while Yap has a greater percentage of savanna grass and fern lands than the rest of the FSM. There is need to update vegetation maps so that we can learn how the vegetation of the FSM has changed in the last 25 years.

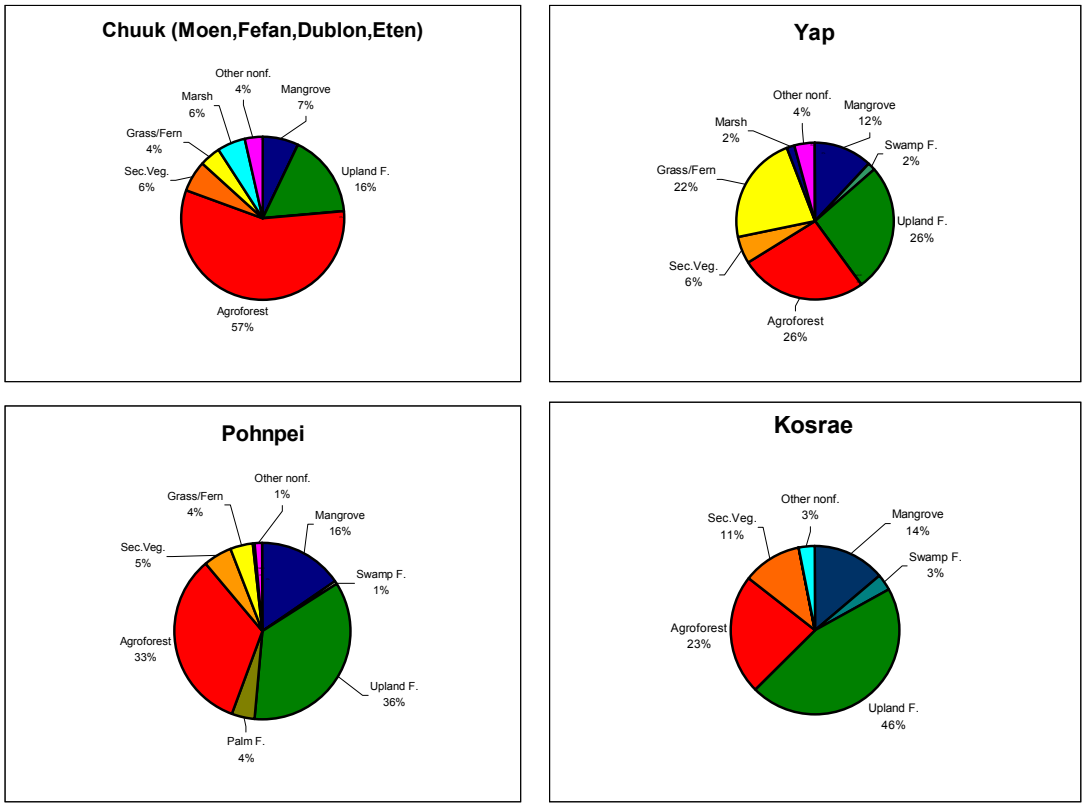


Figure 1. Major vegetation types on high islands of FSM

3 Status of FSM Biodiversity

The following is a brief sketch of some components of the terrestrial biodiversity in the FSM. In general, the FSM has not been thoroughly collected, existing literature is scattered and our knowledge is not complete. This section therefore includes preliminary information on vascular plants and vertebrates. The inventorying and monitoring of the biodiversity of the FSM should be part of the strategy and action plan for the FSM NBSAP.

3.1 Plants

3.1.1 Native and endemic species

There are over 1239 species of ferns and flowering plants in the FSM. Approximately 782 species are native, including about 145 native species of ferns, 267 native species of monocots, and 370 native species of dicots reported in the checklists of Fosberg et al. (1979, 1982 and 1987). While a number of new records are known, this summary of vascular plants is based on the published checklist in order to be consistent. Among these native species of plants there are many endemic species. These are plants that are found nowhere else in the world but on one or more islands in the FSM. An authoritative listing of endemic species of the FSM per se does not yet exist and is needed. Fosberg et al. (1979-1987) report that endemic species found in the Caroline islands, including Palau, include 26 endemic pteridophytes in the Carolines and two more found in both the Carolines and Marianas; 135 monocots restricted to the Carolines, and another 11 shared with the Marianas; 267 dicots endemic to the Carolines, and another 24 shared with the Marianas for a total of 465 endemic species. The only main island of the FSM for which there is a published flora is Pohnpei (Glassman 1952), and this flora which was written some 50 years ago, reports some 80 endemic species known at that time. There are many endemic species of plants in other states as well. To come up with an authoritative list of species that are endemic to the FSM will take considerable work and time. It is an important thing to do, and should be a part of our biodiversity strategy and action plan.

3.1.2 Introduced species

Over 457 species have been introduced to the islands of the FSM by the first Micronesians and subsequent visitors and settlers. The introduced species include a set of food plants and plants useful for other purposes that were brought by early Micronesians. Selection over the thousands of years that Micronesians have inhabited the FSM has resulted in a rich diversity of cultivars of a number of these species. This heritage of cultivars has not been well documented. More recent introductions include cultivated species such as food plants and ornamentals which require people's care, species which have naturalized and live and reproduce without people's care, weeds, and a growing number of invasive species that spread out of human or natural control and are a threat to native species. Approximate numbers of native and introduced species in the four states of the FSM are shown in Table 3 which is based on the checklists of Fosberg et al 1979-1987. The numbers of introduced species has increased since the compilation of this checklist.

Table 3. Approximate numbers of native and introduced species of plants in states of the FSM . Data derived from Fosberg et al, 1979, 1982, and 1987.

Island	Ferns		Monocots		Dicots		Totals	
	Native	Introd.	Native	Introd.	Native	Introd.	Native	Introd.
Yap	45	2	144	64	187	176	376	242
Chuuk	45	3	95	61	158	108	298	172
Pohnpei	106	4	138	90	194	197	438	291
Kosrae	74	0	121	51	121	51	250	72

3.1.3 Invasive species

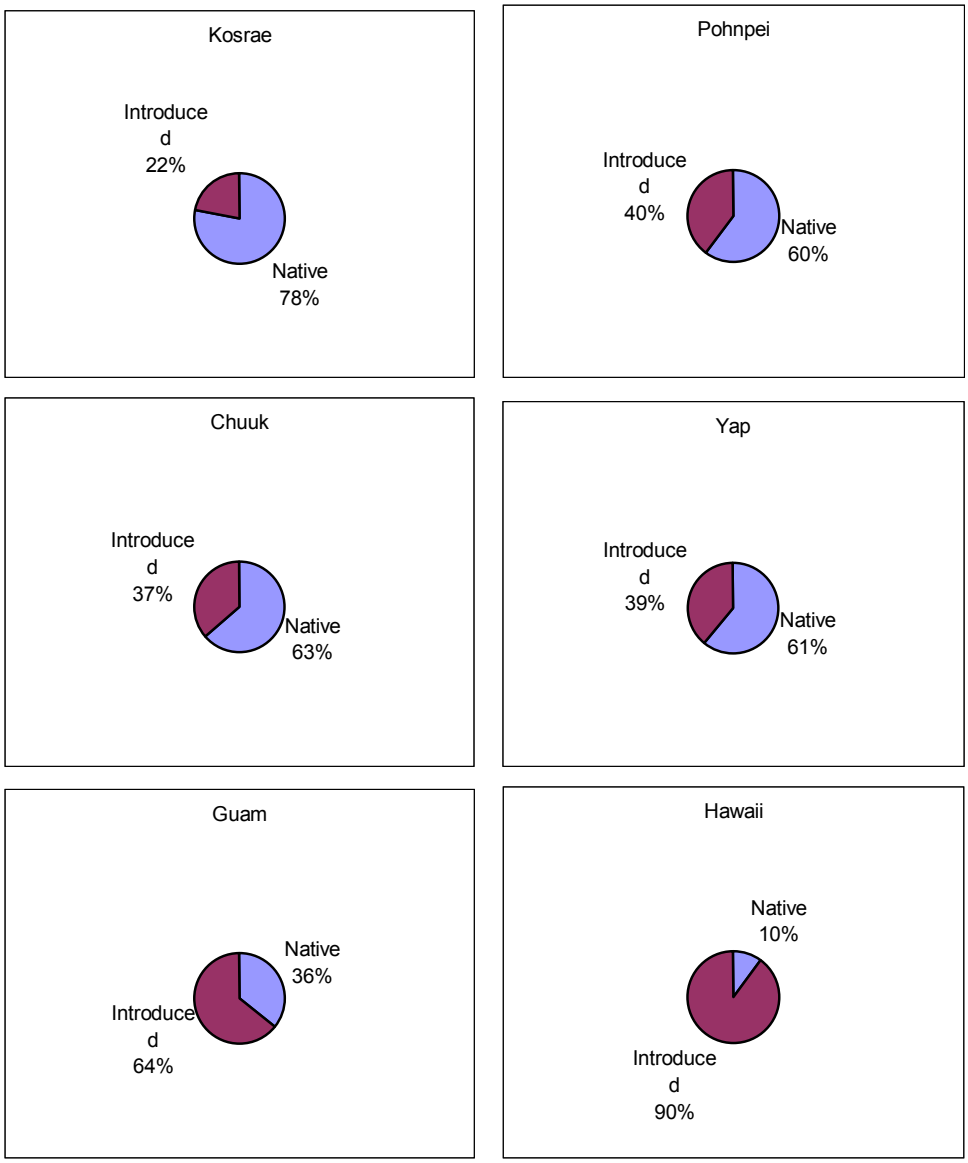
Some introduced species become invasive and spread out of people's control and out of natural control as well. They compete with native species and in time may replace native species and disrupt natural communities. As native plants are replaced by invasive species, other species that depend on them are affected and natural communities are weakened. Even traditional shifting agriculture is affected as invasive species prevent trees from growing back in fallowed garden sites. Invasive species may also increase the frequency and intensity of wildfires and encourage foreign pests that may lead to an inordinate use of pesticides that are dangerous to everything else. The ecosystem gets out of balance and is weakened as biological pollution takes over.

A number of invasive species entered Micronesia as a result of World War II. More recently, invasive species have been spread by equipment used in road construction, and through western style agricultural projects. As more planes and ships come to the FSM, more and more invasive species are introduced. As more and more native habitat is bulldozed and burned away, islands become more vulnerable to invasive species. Often there is an "incubation period" before an invasive species takes off. Then some adaptation or shift in ecological balance triggers an explosive invasion. Explosions of invasive species often occur after typhoons and severe droughts.

To help prevent invasions, we should become aware of the landscape around us, learn about our native species, use them in landscaping and realize that our island's native ecosystem is worth preserving. Keep out plants and animals that are not already in the FSM and obey quarantine regulations. Clean off weed seeds from shoes and clothing while traveling. Maintain native vegetation so that invasions don't have a place to start. Report any new or unusual plants or animals. Watch out for explosions of invasive species in places that are disturbed by bulldozing, droughts and typhoons. Develop emergency response capability to stop invasions before they get out of control. Support eradication, control and integrated pest management efforts. Examples of some invasive species are shown in Appendix II. The introduction of more and more foreign plants to the FSM tends to disrupt natural communities. Figure 2 shows the approximate

percentage of native and introduced species of plants in states of the FSM, Guam and Hawaii. These graphs indicate that the more an island is developed commercially, and becomes a crossroads, the smaller the percentage of native plants. Today, many of Hawaii's native plants are endangered. If we do not want the same thing to happen in the FSM, then we need to make a conscious effort to protect native species. For more information on invasive species of plants in Micronesia, see: P.I.E.R./ Pacific Island Ecosystems at Risk website: http://www.hear.org/pier

Figure 2. Approximate percentages of native and introduced species in the FSM, Guam and Hawaii



3.2 Animals

3.2.1 Mammals

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 keystone species essential to the long-term survival of forests as they serve to pollinate and disperse seeds of forest species. Other mammals have been introduced including at least 3 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.)

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. The endangered species act of the Trust Territory of the Pacific Islands that has been carried over to the FSM lists the *Dugong*, Blue whale *Balaenoptera musculus* and Sperm whale *Physeter catodon* as endangered species.

3.2.2 Birds

Some 119 species of birds have been reported in the FSM. These include 31 resident seabirds, 33 migratory shorebirds, 19 migratory land or wetland birds and 5 vagrant species (Engbring et al. 1990). 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.

Table 4. Categories of birds recorded from the four states of the FSM (after Engbring et al. 1990)

State	Native land & wetland residents	Resident seabirds	Non-resident seabirds	Shorebirds, migrants and vagrants	Introduced birds	Totals
Kosrae	10	5	9	16	2	42
Pohnpei	20	11	8	20	3	62
Chuuk	17	11	10	33	2	73
Yap	13	6	12	50	3	84

A number of Micronesia's birds are declining in numbers and becoming rare. Buden (2000) reports a reduction from the previous survey in total birds per observation station for 18 native resident land birds ranging from 67.4 - 78% in each of 6 major elevation zones. 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.

3.2.3 Reptiles and Amphibians

The least understood group of vertebrates in the FSM are the reptiles and amphibians. There is one introduced amphibian (*Bufo marinus*), and over 27 species of reptiles, all but about two of them being native or possibly introduced with the first human colonists. The reptiles include about 22 species of lizards and at least one snake, the Braminy blind snake *Rhamphotyphlops braminus*. Several species of sea snakes have also been recorded. Among the lizards of the FSM is at least one endemic skink: *Emoia ponapea*, found only in Pohnpei. *Perochirus scutellatus*, the giant Micronesian gecko, thus far is known only on Kapingamarangi and Ulithi atolls, but whether it is endemic to the FSM and overlooked elsewhere, or is a relict species more widely distributed in the past is unknown (Buden 1998). Studies of the reptiles of Micronesia are incomplete, and it is likely that there will be additional records as well as new species. There are also at least four species of sea turtles in the FSM including *Chelonia mydas, Eretmocheleys imbricata, Dermocheleys coriacea* and *Lepidocheleys olivacea* (Buden and Edward 2001, Falanruw 1975). A few crocodiles have turned up in Yap and Palau in the past.

3.2.4 Invertebrates

While there has been some work done on the terrestrial invertebrates of the FSM, reports are scattered, and mostly located outside of the FSM so that a review of FSM's invertebrates was beyond the scope of this preliminary report. There are indications however that the invertebrate fauna of the FSM is rich and interesting. Recent literature surveys and collections in Pohnpei and Kosrae for example suggest that there are 27 endemic species of land snails and 50 species of ants (Raynor pers. comm.). The forests of Chuuk are host to a giant millipede that seems to occur only in Chuuk and Palau in Micronesia and fireflies (beetles) occur on Yap (Falanruw pers. observ.)

4 Outstanding Features of Each State of the FSM

Each state of the FSM has its own outstanding features and biodiversity treasures. Kosrae has magnificent swamp forests dominated by endemic *Terminalia carolinensis* and *Horsfieldia nunu* trees. Pohnpei has the most endemic species in the FSM, Chuuk is also high in endemics and has some of the most endangered forests in the FSM. Yap has

the most diverse mangroves and agroforests in the FSM. Atolls also have special features such as uninhabited islets with "inland mangroves" (such as *Bruguiera gymnorrhiza*) that apparently make use of the fresh or brackish water lens toward the interior of the islet. Uninhabited islets of atolls are also very important as sites of seabird and sea turtle rookeries and also provide sites for coconut crab larvae to come ashore and develop.

Figure 3. Seabirds flying over Euarpik atoll. Photo by Pius Liyagel

Each state of the FSM has its own set of endemic species: species found nowhere else in the world. Some states share endemic species. A few examples of some of the endemic plants and birds of FSM states are shown in Table 5 below, and illustrated in Appendix I.

Table 5. Examples of some endemic species of each state of the FSM

Pohnpei	Kosrae	Chuuk	Yap
Some plants:			
Parkia korom	***Horsfieldia nunu***	***Semecarpus kraemeri***	***Drypetes yapensis***
Dendrocnide kusiana ----------		***Randia carolinensis - - - - - - - -***	
Garcinia ponapensis	***Elaeocarpus kusanoi***	***Schefflera krameri***	***Garcinia rumiyo***
Aglaia ponapensis	***Selaginella kusaiensis***	***Hoya trukensis***	***Pandanus japensis***
Some Birds			
Pohnpei Lory ***Trichoglossus rubiginosus***	**Dusky White-eye** ***Zosterops cinera***	**Truk Monarch** ***Metabolus rugensis***	**Yap Greater White-eye** ***Rukia oleaginea***
Pohnpei greater white-eye ***Rukia longirostra***		**Truk greater white-eye** ***Rukia ruki***	**Yap Monarch** ***Monarcha godeffroy*i**

5 Species and Habitats in Peril

5.1 Species in Peril

Many impacts on the natural environment threaten biodiversity and there have already been extinctions in our area (Steadman 1995). There are gaps in species distributions that 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.

World concern for species that are becoming rare and in danger of extinction, has resulted in a number of listings of threatened, endangered and other categories of "species in peril". The most prominent of these lists 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.

5.1.1 The International Union for the Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species

The IUCN Species Survival Commission has been in existence for almost four decades and assesses the conservation status of species, subspecies, varieties and even selected sub-populations on a global scale in order to highlight taxa threatened with extinction, and thereby promote their conservation. The IUCN Red List of Threatened Species is the most comprehensive, apolitical global approach for evaluating the conservation status of plant and animal species.

The current IUCN list can be accessed at http://www.redlist.org . This site provides a database that can be searched online. It lists 88 species from the FSM under different categories. Table 6 below includes all the species listed for the FSM other than those that are classified as "DD" for "data deficient". (The coconut crab is listed as "DD", but since it is well known and important to Micronesians, it is included in Table 6 as well).

The goals of the IUCN Red List are to: provide a global index of the state of degeneration of biodiversity; and to identify and document those species in most need of conservation attention. The actual protection of threatened species is then addressed through a set of regulations at international, national and local levels. These include the CITES convention, the U.S. Endangered Species Act, and the FSM Endangered species act described below.

5.1.2 The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora is an agreement between 130 Nations to prevent species from becoming endangered or extinct because of international trade. It prohibits trade in listed species except under CITES permits and seeks to ensure that international trade in specimens of wild flora and fauna does not threaten their survival. CITES has developed several categories of lists of protected species:

Appendix I: species threatened with extinction.
Appendix II: species for which there are regulations to avoid utilization incompatible with their survival.
Appendix III: species that are protected in at least one country, which has asked for assistance in controlling the trade.

Roughly 5,000 species of animals and 25,000 species of plants are protected by CITES, including the FSM species listed in Table 6. The CITES provides a framework for member parties to develop their own domestic legislation. The FSM is not yet a party to CITES; however countries, which are party to CITES, must adhere to CITES regulations relating to species that are in the FSM.

5.1.3 The United States Endangered Species Act (ESA)

Passed in 1973, the ESA implements U.S. participation in the CITES. It is one of the most comprehensive wildlife conservation laws in the world and seeks to conserve "the ecosystems upon which endangered species and threatened species depend" and to conserve and recover species. Under this law species are listed as "endangered , or threatened". Endangered means a species is in danger of extinction throughout all or a significant part of its range. Threatened means a species is likely to become endangered within the foreseeable future. As of August 31, 2001, 1,802 species are listed, of which 1,244 are U.S. species. The law provides for the designation of "critical habitat" considered essential to the conservation of the species, and which may require special management considerations or protection. FSM species included in the U.S. ESA list of threatened and endangered species are included in table 6.

5.1.4 The FSM Endangered Species Act

The Endangered species Act of the Trust Territory of the Pacific Islands was carried over into the Code of the FSM. Title 23, Chapter 3. Section 303 of the FSM Code states that: "the indigenous plants and animals of the Trust Territory (FSM) are of esthetic, ecological, historical, recreational, scientific, and economic value and it is the policy of the Government of the Trust Territory (FSM) to foster the well-being of these plants and animals by whatever means necessary to prevent the extinction of any species or subspecies from FSM islands or the water surrounding them. Section 306 prohibits "any person to take, engage in commercial activity with, hold possession of, or export any

threatened or endangered species of plant or animal or parts thereof. Section 314 relates to the importation of Endangered species and Section 315 relates to the importation of exotic plants and animals. Species listed in the FSM Endangered species Act include the *Dugong*, Blue whale *Balaenoptera musculus* and Sperm whale *Physeter catodon.*

Table 6. Terrestrial Animals and Plants included in the IUCN Red List, CITES Appendices and U.S. ESA Threatened and Endangered species lists . For conditions and more information, see: www.redlist.org, www.cites.org and http://endangered.fws.gov.

Common names of groups and species	Scientific name of species or group	Listing under IUCN, CITES, and U.S. ESA	Comments
Mammals			
Fruit bats or Flying foxes	*Pteropodidae*	CITES I & II	All members of this family of fruit bats (flying foxes) are protected under CITES I & II
Ulithi Fruit bat	*P. mariannus ulithiensis*	CITES I, U.S. ESA, and Yap State law	covered by U.S. Endangered species act by virtue of being a sub-species/ sibling species of *P.m. mariannus*
Yap Fruit bat	*P. mariannus yapensis*	CITES I, U.S. ESA, and Yap law	covered by virtue of being a sub-species/ sibling species of *P.m. mariannus*
Kosrae fruit bat	*P. mariannus ualans*	CITES, U.S. ESA	covered by virtue of being a sub-species/ sibling species of *P.m. mariannus*
Chuuk Fruit bat	*P. insularis*	IUCN critically endangered, CITES I,	
Pohnpei Fruit bat	*P. molossinus*	critically endangered IUCN, CITES	
Mortlock Fruit bat	*P. phaeocephalus*	IUCN critically endangered, CITES I, endangered	
Caroline sheath-tail bat	*Emballonura semicaudata*	IUCN endangered	
Whales	*Cetacea*	CITES I & II	All whales in the FSM are included in either Appendix I or II.
Blue whale	*Balaenoptera musculus*	CITES, FSM	carried over from TTPI list to FSM list
Sperm whale	*Physeter catodon*	CITES, FSM	carried over from TTPI list to FSM list
Dugong	*Dugong dugong,*	vulnerable IUCN, FSM	carried over from TTPI to FSM listing

Birds			
Pohnpei Mountain Starling	*Apolonis pelzelni*	critically endangered IUCN	
Caroline Ground-Dove	*Gallicolumba kubaryi*	vulnerable IUCN	
White-Throated Ground-Dove	*Gallicolumba xanthonura*	lower risk IUCN	
Chuuk Monarch	*Metabolus rugensis*	endangered, IUCN	
Yap Monarch	*Monarcha godeffroyi*	lower risk IUCN	
Bristle-thighed curlew	*Numenius tahitiensis*	vulnerable, IUCN	
Large Pohnpei white-eye	*Rukia longirostra*	lesser risk IUCN	
Chuuk or Faichuk white-eye	*Rukia ruki*	critically endangered IUCN	
Plain white-eye	*Zosterops hypolais*	Lesser risk IUCN	
Yap olive white-eye	*Zosterops oleaginous*	Lesser risk IUCN	

Reptiles			
Leatherback sea turtle	*Dermochelys coriacea*	CITES	known from at least Yap and Pohnpei
Pacific green sea turtle	*Chelonia mydas agassizii*	IUCN endangered . CITES II, U.S. ESA	throughout the FSM
Pacific hawksbill sea turtle	*Eretmocheleys imbricata*	critically endangered IUCN, CITES, U.S. ESA	throughout the FSM
Olive ridley sea turtle	*Lepidochelys olivacea*	CITES	reported from Yap (Falanruw 1975)
Crocodiles *398	*Crocodylus spp.*	CITES I or II	A few crocodiles have been reported from Yap and Pohnpei.
Monitor lizards	*Varanidae: Varanus indicus & spp.*	CITES	*Varanus indicus* is reported from many areas of the FSM, but the species in Yap may differ.

Crustaceans (Crabs)			
Coconut crab	*Birgus latro*	IUCN data deficient	included here because importance of coconut crab islets
Molluscs (Land snails)			
	Partula guamensis	endangered IUCN	
	Partula emersoni	critically endangered IUCN	
	Partula martensiana	critically endangered IUCN	

PLANTS			
Common names of groups and species	Scientific name of species or group	Listing under IUCN, CITES, U.S. ESA, and FSM	Comments
Tree ferns	*Cyathea spp.*	CITES	
Cycadaceae	*Cycads*	CITES	all parts except seeds, seedlings, propagated plants
"looking-glass tree"	*Heritiera longipetiolata*	vulnerable IUCN	
Ivory nut palm	*Metroxylon amicarum*	vulnerable IUCN	
Korom	*Parkia korom*	vulnerable IUCN	
	Pericopsis mooniana	vulnerable IUCN	
Euphorbiaceae	*Euphorbia spp.*	CITES	
Mahogany	*Swietenia mahagoni*	CITES	Introduced in the FSM
Pitcher plants	*Nepenthes spp*	CITES	all parts except seed, seedlings in vitro, cut flowers or artificially propagated
Orchids	*Orchidaceae*	CITES	

5.1.5 Other U.S. Legislation relating to species in peril

Other U.S. laws relating to the protection of species and habitat include the Marine Mammal Protection Act, the Migratory Bird Treaty Act and the Anadromous Fish Conservation Act. The Lacy Act makes it a crime to trade in or possess protected species. In addition to these laws, the U.S. has recently passed legislation to require fishing vessels to carry whole carcasses of sharks along with their fins. The intent of the law is to reduce the killing of sharks for their fins alone, and thereby reduce the harvest of

sharks. There is growing evidence that sharks are likely to be in the first round of marine extinctions caused by human activity. Sharks are very vulnerable to overexploitation due to their longevity, late maturity and slow reproduction rates. In some areas of the FSM such as Fais, 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. What little data there are on commercialized shark fisheries shows a "boom and bust" pattern. Because of the low reproduction and low recruitment levels, populations of sharks are very slow to recover from such exploitation. For more information on the status of sharks see www.wildaid.org.

Commercial exploitation of sharks thus poses a great threat to subsistence fisheries. It also poses a threat to the FSM's developing dive industry. Visiting divers, cherish encounters with sharks and sharks are quite valuable to the dive industry. The shark fin trade affects our visitor industry in other ways as well. The practice of shark finning involves cutting the fins off of live sharks and throwing them back in the water. This is seen as a barbaric practice and shark finning has been banned in a number of countries including Canada, Brazil, the United States, much of Australia, and most recently, Palau. Visitors to Yap have expressed disgust that shark finning appears to be tolerated in the FSM (figure 4).

Figure 4. Shark fins drying aboard Taiwanese fishing boats anchored at Yap State Fisheries dock .

5.1.6 Development of an FSM list of species in peril

The FSM should begin work on it's own listing of "species in peril". The best place to start is with species that are not found anywhere else in the world. Endemic species that are becoming rare are prime candidates for a "species in peril" list. The YINS has compiled a list of native plant species that are known from only one or a few islands in the FSM. Most of these are endemic species. Some are not. In order to sift out those that also occur somewhere else, we would need literature and records not available in the FSM. For this we need to seek outside help. In the meantime, individuals and groups in the FSM can proceed to enhance existing lists with local names and occurrence data (where they are and how common or rare they are). Work on local names can begin with the checking and expanding on the cross-indexed names of common and scientific names of trees and shrubs of Micronesia (Falanruw et al. 1990). Pohnpei already has a collaborative project on its flora. Chuuk may use the extensive biodiversity dictionary developed by Davis (1999). Each state should have a point person or group and support to work on this effort. In developing lists of local names of flora and fauna participants will become aware of the occurrence of important species and be able to contribute to the listing of species in peril, and eventually to an FSM listing of threatened species.

5.2 Habitats in Peril

In order to protect biodiversity we must maintain the habitat of particular species. Threats to natural habitat in the FSM include both human activities such as bulldozing, wildfires, clearing for agricultural activities, roads and other constructions; and natural impacts such as drought and climate change. It will be some time before the FSM carries out a thorough inventory of species in the FSM, their status and relative abundance or scarcity. It is very important therefore that we begin to define and protect remaining areas of natural habitats for species in peril. Some of the more threatened natural communities include:

5.2.1 Cloud Forest

The cloud forest of Pohnpei and Kosrae are unique and among the lowest elevation cloud forests in the world. They are high in endemic species and very vulnerable to disturbance, and should be protected.

5.2.2 Native Forest

Impacts on native forest are increasing and we do not have a system for monitoring the condition of native forests in place. Only in the case of Pohnpei do we have any data on changes in the general upland forest type. Here the area of upland forest decreased from 42% of the total vegetation cover in 1975 to only 15% in 1995 (Trustrum 1996).

While the decrease in area of native forest in Pohnpei appears to have been exacerbated by upland shifting sakau culture, forests of the other three states of the FSM have also been subjected to serious impacts the most prominent of which are: bulldozing activities, storms, drought, wildfires, invasive species and shifting agriculture. There is need to identify, demarcate and monitor forest community types lumped into the "upland forest"

type mapped in the USFS vegetation maps, in order to define forest communities in special need of protection. Only remnants of native forest remain in Chuuk and Yap. These areas should be identified and protected. These forests are generally in less accessible places, such as the tops of mountains in Chuuk, small in area, and more valuable for their ecological services and genetic heritage than for economic exploitation.

5.2.3 Native fresh water marsh and riverine systems

Although there is a great deal of marshland dominated by *Phragmites* reeds in the FSM, the area of marshes with other native vegetation is much more limited and should be protected. This should pose no agricultural hardship because of the abundance of *Phragmites* marsh that can be used for taro patches. Freshwater riverine systems represent isolated environments within islands where unique native species may occur.

5.2.4 Swamp Forest

The swamp forests of the FSM are unique, especially in Pohnpei and Kosrae where endemic species of trees are dominant. Swamp forests are important for both the materials they provide and for their ecosystem services which include serving as silt traps, buffering fresh water resources and quality, and contributing to the health of mangrove systems. These forests are under heavy pressure from road construction and conversion to taro patches. It is important to maintain enough area of swamp forest in the especially high and wet islands of Kosrae and Pohnpei to maintain their ecological functions. The swamp forest type in Chuuk and Yap has largely been disturbed and converted to *Phragmites* marsh and taro patches. Remnants of swamp forest in these islands are worthy of protection. In Yap for example, a species previously found only in Palau has recently been discovered in a remnant bit of riverine swamp forest.

5.2.5 Mangrove Forests

Throughout the FSM, mangrove forests are under threat from roads altering the flow of freshwater, dredging operations, oil spills, overharvesting for firewood and other threats. 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.

5.2.6 Uninhabited islets of atolls

A number of uninhabited atolls or islets of atolls serve as important sites where coconut crab larvae come ashore and develop, or serve as important rookeries for seabirds and turtles that gather there from a wide area. It is important to protect these nesting areas. At the present time, one of the important sea turtle nesting sites in Ulithi atoll is threatened by a potential oil spill from a sunken ship located upwind from the turtle islands, with approximately 9.2 million gallons of oil.

6 Recommendations

A great many recommendations could be made for gathering data on, and improving stewardship of, the biodiversity of the FSM. A pre-requisite for such efforts however, is the development of a local context within which such activities can occur. Some steps in this process follow.

6.1 Restructuring for sustainable stewardship of natural resources

The current structure of the FSM government is derived in a large part, from the structure inherited from the former Trust Territory of the Pacific Islands government. The TTPI government was, in keeping with the paradigms of that era, focused on political change and economic activities. The important paradigm of "sustainable development[1]" had not yet developed. As a result, there was little government structure devoted to biodiversity preservation and stewardship. There was for example, only one conservation officer for all of the TTPI - the area that has become the Commonwealth of the Northern Marianas, the FSM, the Republic of Palau and the Republic of the Marshall Islands. The current FSM national government of the FSM does not have a position for a conservation officer, nor are there conservation offices at the state level. Instead, matters affecting "the environment" are scattered throughout a number of small government agencies whose responsibilities are, in some cases not well defined or related to one another. In some cases, the government is in the awkward position of being responsible for monitoring itself, or is in a position of promoting economic exploitation of resources at the same time that it is supposed to conserve resources.

Most government agencies dealing with natural and historical resources receive much of their funding through U.S. Federal grants. This tends to orient these agencies to policies and procedures of their grant givers rather than working with other local agencies toward local objectives. Only at the national level is there a Council on Sustainable Development, and only in the state of Kosrae is there a consortium of government agencies whose work relates to the environment. There has been little formal connection between "The Government" and the nongovernment sector of Municipalities, NGOs and local eco-enterprises such as diving operations and eco-tourism businesses, and local entrepreneurs exploiting natural resources on a commercial basis such as local exporters of reef fish, shellfish, and formerly at least, fruit bats. Indeed, little or no data is generally gathered on such exports.

Until recently, there were only two local NGOs whose work related to the natural history of the FSM, and these NGOs have had to operate at a bare subsistence level. As a result,

[1] Sustainable development refers to long-term cultural, economic, and environmental health and vitality. It is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. For small islands especially, economic development must be ecologically sound. While there are ecological limits to sustainable exploitation, there are no limits to making life on our islands better and better.

the private/ non-government concerns for biodiversity and the environment which served to usher in the "environmental era" in the United States and other countries have not been well-developed in the FSM. Finally, the FSM has few citizens educated in natural history fields. One reason for this is that there are few jobs or other opportunities in these fields. Government positions relating to natural resource stewardship are very limited. For example, in Yap State, there is but one position, that of "State Forester", salaried as an agricultural aide, relating to Terrestrial biodiversity. In the Marine area there are but two FSM professional positions funded at the Division of MRMD. If we are to fulfill our commitment to the COB, some restructuring will be necessary to develop both government staff capacity as well as a functional partnership between government, non-government groups and communities. Other steps follow.

6.2 Depositories for information on FSM biodiversity

This report gives a general idea of the status some groups included in the biodiversity of the FSM. It is not complete, and admittedly leaves out some very important groups (such as arthropods and insects!) The TNC Pohnpei office, YINS and other groups in the FSM have additional materials that have not been compiled here. At this point, it seems more important to develop a context for such information. Scientists have been visiting the FSM for many years making collections. The results of some of their work have been reported back, some has not. Even the reports that have been sent back have not been deposited in one place, much less used. One of the first steps in inventorying the biodiversity of the FSM is the designation of a depository for such information in each State of the FSM as well as in Pohnpei. Researchers using the FSM for their field studies may then be asked to contribute relevant literature in their field.

6.3 Process for tracking researchers

An improved system to track visiting scientists and specialists is needed. At the present time, some researchers are asked to register with the Office of Historic Preservation. In many cases, biological scientists do not go through this process. At least in the case of Yap State, State law refers to anthropological research and overlooks the natural sciences. There is no database to track visiting scientists and their work, even in the case of those who are polite enough to check in with the HPO office during their visit. A more comprehensive system is needed. Associated with this effort is the development of 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 prevent biopiracy.

6.4 Enabling visiting scientists to contribute to the development of local capacity

In considering the state of knowledge about the biodiversity of the FSM, one cannot help but notice the discrepancy between the large number of visiting scientists and the very limited number of resident scientists in the FSM. In the interest of developing local capacity in biodiversity, it is reasonable to develop a system through which visiting

scientists would contribute to the development of local capacity. This might take the form of a research permit system (as is present in other Pacific nations) that includes a requirement for visiting scientists to hire local counterparts or apprentices. One of the most effective ways to develop local professionals is to provide employment opportunities for residents to work with visiting professionals. Most visiting scientists are nice people who are willing to have local people work with them, but do not have budgets to employ local counterparts or apprentices. Most budding naturalists have family and other obligations that limit their freedom to work with visiting scientists on a voluntary basis, as might be the case in more wealthy countries. If the developed world is serious about developing scientific capacity in third world countries, grant agencies must require that the employment of local counterparts or apprentices be included in grant proposals, and budgets. The FSM should request this positive action.

6.5 Accommodating outside groups interested in the Biodiversity of the FSM

There are a good number of outside groups interested in studying the biodiversity of the FSM. These groups include college students and faculty as well as biologists affiliated with museums and other research institutions and Federal and International agencies. Many of these groups are able to obtain grants to work in the FSM. In some cases, the grants are for work that could be done by expertise already within the FSM. In other cases, there is no one in the FSM specialized in the field for which grants are given. In the interest of making the best use of financial resources, and of developing local capacity as well as local economies, some type of a clearinghouse mechanism is needed. Such a clearinghouse mechanism should be organized to accommodate a graduated sequence of specialization and expertise ranging from ecotourists to eco-educational tours to eco-research visitors.

6.5.1 Eco-tourists

Many of the people who can afford to visit Micronesia for eco-tourism purposes often have well developed interests. "Fairly serious" bird watchers for example can be quite well versed in their avocation. We need to develop local specialists to accommodate and learn with this category of visitors. Since such visitors are generally willing to pay their guides, this process will become self-sustaining.

6.5.2 Eco-education

The islands of FSM are attractive as learning environments. Natural communities are condensed into small areas simplifying logistics and making it easier to see how "the parts" of an ecosystem fit together. The FSM is also a safe and friendly place for students. We have a good "product" and need to develop this mutually beneficial "niche market".

6.5.3 Eco-research

The FSM is valuable as an area for which outside researchers can obtain grants to work, and better management of this resource is needed. At the present time the government often provides staff and logistic support to visiting scientists. In cases where the research

contributes to the work of government agencies, such collaboration can be valuable. In cases when the research isn't as relevant the provision of staff and logistic support takes the small staff of FSM agencies away from ongoing responsibilities and utilizes Public funds to compete with the local visitor industry. Most visiting researchers would not mind contributing to the local economy in a helpful way. We need to develop ways for them to do so. This is particularly important in those States where most land and sea areas are held in customary tenure. At the current time there is no system through which visiting researchers may ask permission to work in privately held lands and waters. This results in a default situation where a local government employee or guide is in the awkward position of having to bring strangers into private lands and waters, or risk being "impolite" to the visitor. Besides being awkward for the guide this provides an unfair subsidy for visiting researchers over resident scientists who must provide for their own logistics and respect private property. Some type of a clearinghouse enterprise is needed to both accommodate visiting researchers as well as to contribute to local capacity development and benefits.

7 Networking with Activities relating to Biodiversity in the FSM

A clearinghouse mechanism is needed to allow local expertise to network with regional and other groups doing work on the biodiversity of the FSM. In the course of developing this NBSAP for example, we undertook to develop bibliographies on the flora and fauna of the FSM not realizing that the Bishop Museum had received a grant some years ago to compile a bibliography on Pacific biodiversity. The B.P. Museum has digitized the valuable Island Bibliographies and Supplements by Sachet and Fosberg (1955, 1971) and updated the bibliography through about 1998. Had we known about this effort, we could have made good use of the resulting electronic bibliography.

More recently, the Bishop Museum has received a grant with The Nature Conservancy from the MacArthur Foundation to fund the development of species richness maps for corals, fishes and mollusks. They also have another grant to develop comprehensive checklists of vertebrates and vascular plants of Micronesia. These efforts overlap with the work that we are doing for the FSM Biodiversity program and some coordination is needed to allow the development of local capacity as part of the process.

Another Activity that relates to the biodiversity of the FSM is the PABITRA network of the Ecosystem Division of the Pacific Science Association Task Force on Biodiversity. This effort has been in process since 1994 and has resulted in annual meetings on Asian and Pacific biodiversity. In 1998, a Pacific-Asia Biodiversity Transect (PABITRA) was initiated. Two branches of this transect will run through the FSM, and it would be well if the FSM were involved. The fifth PABITRA workshop was held on Guam shortly after the first NBSAP meeting but there was no participation by the FSM. Upcoming events include a GBF Biodiversity Forum for the Pacific, and a workshop at the Pacific Science Congress 17-21 March 2003. It is recommended that the FSM join the Pacific Science Association and designate and obtain support to send local scientists to participate in events such as these.

8 Framework for a functional biodiversity program

It is clear that more information is needed on the biodiversity of the FSM. An even more immediate need is the development of a functional framework for such work. This entails improved coordination of government programs, partnerships with local NGOs and communities and management of the resources of outside agencies and institutions so that the development of local capacity can go hand in hand with the gathering of information on the FSMs biodiversity. The development of means to support biodiversity professionals must also go hand in hand with their development. This will require both an immediate initial investment from U.S. and international sources of support for biodiversity work as well as a long-term mechanism for sustained support. These two mechanisms are potentially at hand through an environment sector of the renegotiated Compact and the Micronesian Conservation Trust respectively. While work is progressing to develop an adequate support base, local capacity and a data base on biodiversity, it is essential that we also begin defining habitat and species in need of protection and enhanced stewardship as well as the Public awareness that will be required to care for and sustain the FSM's natural heritage. The FSM must find ways to make economic development ecologically sustainable. A set of indicators of sustainable development and a system for monitoring these indicators should be developed and incorporated into State and National development plans and programs. Given the natural heritage of the FSM and the ecological crises facing the world, becoming expert at sustainable livelihoods is a necessity that could become the role of the FSM among the nations of the world.

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