

I. The Environmental Context

The Samoan Archipelago comprises six major islands. The islands vary in their geomorphology as a consequence of relative age, secondary volcanism, erosion from rainfall, and the forces of the sea. The Samoan environment also varies considerably in terms of soil, vegetation, and marine resources. Adding to this mosaic are complex human-induced changes that have, over three millennia of occupation, transformed much of the Samoan environment into a productive economic landscape.

Climate and Vegetation.

Samoa lies within the humid tropics. At 14°S latitude, the islands are in a zone where temperature and humidity are nearly constant and rainfall abundant. Average temperatures vary from only 25.7 to 26.2° C, with humidity between 80 and 86 percent. The total annual average rainfall (recorded from Tutuila Airport) is 3100 mm (Nakamura 1984: Table 1). Seasonality is expressed primarily in the pattern of rainfall. From June to September drier conditions prevail with monthly rainfall averaging about 175 mm. A wetter season, from October through May, has monthly averages of about 350 mm. Variability in rainfall occurs with extended dry seasons. Droughts can significantly affect agricultural production. The wet season can bring torrential rains and damaging floods--some associated with tropical storms and hurricanes (Nakamura 1984:3).

The hotter, wetter season from October to March brings the risk of tropical storms and cyclones. Coulter (1941:12) notes "Samoa suffers hurricanes at regular intervals during the hotter season." Visher (1925:27, Table 6) indicates an annual frequency of two to three hurricanes in the area of Samoa, some hitting the islands directly and bringing devastation to crops, houses, and human life. These regular, natural catastrophes have helped to shape the environmental history of the islands. The torrential rains cause landslides, and storm surge can reshape the shoreline and configuration of the coastal terrace in a matter of hours.

The volcanic origin of the Samoan landforms yields predominantly undifferentiated parent material for soil formation. The basic parent materials are derived from volcanic rocks. Volcanic ash and cinders from eruptions are also common sedimentary parent materials. Colluvium and alluvium form parent materials for many soils as well. A limited number of soils have formed in organic material and coral sand--in geologically young coastal terraces. Many Samoan soils are young, reflecting both geologic age of the islands and the dynamic geomorphology that frequently exposes new surfaces (Nakamura 1984:57-58). Large areas of Samoa have well drained, well watered, fertile soils. The steep slopes of the mountain ridges are a primary limiting

factor on the availability of arable land.

Samoaan flora is typical of the well watered, tropical, island environments of the region. Yuncker (1945:4), for Manu`a, lists 421 taxa, including mosses, pteridophytes, and flowering plants, in his botanical survey of the three islands. Many species found in undisturbed habitats are endemic to Samoa. However, large portions of the Samoaan landscape have been modified at one time or another by human activity. These anthropogenic landscapes represent areas of natural vegetation transformed into economic ones.

Whistler (1981) made a comprehensive study of Samoaan vegetation, classifying zones to describe general plant distributions. The littoral vegetation includes several taxa that are native and adventive. This zone is subject to the effects of sea spray and occasional storm conditions. The plants include coconut, pandanus, creeping vines, grasses, and succulent herbs. Wetland vegetation includes freshwater coastal marshes and saltwater mangrove forests. Wetland vegetation has become rare because these areas come under agricultural use or have been cleared to open coastal land and waterways. Tropical rainforest covered the vast majority of Samoa before humans modified the landscape for agricultural purposes. These rainforests include the coastal, ridge, lowland, montane, and cloud zones, governed by conditions of altitude, moisture, and soil drainage.

Vegetation surveys show one of the largest zones is that classified as "disturbed" or anthropogenic. This zone consists of land that is currently under swidden (slash and burn) cultivation, or has been abandoned and is slowly reverting through successional stages to natural vegetation patterns (Whistler 1981). Hurricanes have also played an important role in disturbing the vegetation in Samoa (National Parks Service Draft 1988: 16).

In sum, vegetation patterns in much of Samoa reveal its three millennia of human land use. The vegetation of the lower elevations and coastal terrace of the islands are dominantly anthropogenic, reflecting "transported landscapes" of the adventive root-tuber and tree crop complex of Oceania. Vegetation in these zones is comprised of a mosaic of coconut stands, breadfruit and banana orchards, and aroid gardens interspersed with secondary growth. On the higher, steeper slopes of the main islands, rainforest vegetation persists.

The vertebrate terrestrial fauna of Samoa is restricted, but is somewhat richer in invertebrates (landsnails and insects). The only indigenous mammal is the fruit bat, *Pteropus samoensis*, found in abundance and once commonly taken for food throughout Samoa. The Pacific rat (*Rattus exulans*), the domestic pig (*Sus*

scrofa), and dog (*Canis familiaris*) were introduced prehistorically by Polynesians. Several other animals were introduced in historic (i.e., post-European contact) times, including cattle, horses, cats, goats, and rats.

The avian fauna in Samoa includes native landbirds and nesting seabirds (Watling 1982). In the higher elevation forests of the main islands are found the lupe or Pacific Pigeon (*Ducula Pacifica*) and the manutagi or Crimson-Crowned Fruit Dove (*Ptilinopus porphyraceus*); both have been occasionally taken for food. White-Collared Kingfishers or ti`otala (*Halcyon chloris*), Banded Rails or ve`a (*Gallirallus philippensis*), the Polynesian Starling, mitivao (*Aplonis tabuensis*), and the iao or Wattled Honeyeater (*Foulehaio carunculata*) are relatively common in the coastal bush and gardens of Samoa.

A variety of seabirds and some migratory birds also nest in the archipelago. These include the tava`e, White-Tailed Tropic bird (*Phaethon lepturus*) and the seasonal migrant, tuli or Golden Plover (*Pluvialis dominica fulva*). However, as Steadman (1993) has shown at least for Manu`a, the contemporary avifauna of Samoa is a significantly reduced remnant of a richer pre-human bird life.

The only other vertebrates in Samoa are reptiles in the families *Geckonidae* and *Scincidae*. These include 15 species of amphibians and reptiles, as reported for the Island of Tutuila (National Parks Service Draft 1988:19).

Finally, the islands of Samoa have a rich and varied marine environment providing an important source of dietary protein to its human populations. Much of the coastline of the Samoan Islands is surrounded by fringing reef, providing micro-habitats for abundant fish, shellfish, and other food resources exploited by the residents. A diverse array of shellfish inhabit the reefs. The reefs are also home to spiny lobsters (*Panulirus* sp.), sea urchins (echinoderms), sea slugs (holothurians), octopus, and several edible seaweeds. These are important seafoods throughout Samoa. Approximately 800 taxa of inshore fishes occur in Samoan waters (Jordan and Seale 1906) and comprise a significant part of the traditional Samoan diet. As discussed further below, among the fish commonly taken are jacks (*Caranx* spp.), parrot fish (*Scarus* spp.), wrasses (*Labridae*), and acanthurids. The open sea beyond the reef provides rich pelagic resources, such as the prized tuna (*Scombridae*). Marine turtles (*Chelonia mydas* and *Eretmochelys imbricata*) are seen in Samoan waters today, but undoubtedly were once more common.

The National Park Environments.

The National Park of American Samoa includes areas on three islands, Tutuila, Ofu, and Ta`u. The park areas on Tutuila and Ta`u include a comparable range of landforms, vegetation zones, marine environments, and traditional Samoan land use. The Ofu unit is primarily reef, but includes a narrow strip of coastal land.

1. Tutuila Unit. Tutuila, third in size after Savai`i and `Upolu (Western Samoa), is a high volcanic island with an area of about 142 square kilometers. It is long and narrow with a high ridge running down the center of the island. Tutuila is very rugged, with numerous peaks, and ridges of an old volcanic caldera. The highest peak on the island rises 653 meters above sea level, with only 34% of the island comprising less than 30 degree slope. The north coast of the island is more rugged, the valleys smaller, and the bays narrower and fewer in number than along the south coast. The rugged topography of Tutuila with its small area of flat land is reflected in the ancient settlement pattern, with many archaeological terraces and specialized sites (e.g., star mounds) on ridges and steep slopes.

National Park lands on Tutuila extend along the north-central coast, from the central ridgeline (Maugaloa) to the reef edge from near Afono to Fagasa. This land is largely forested, steep (much of the area has a greater than 30 degree slope), and at present under little cultivation. The soils of this area are well-drained and derived from parent materials of volcanic rock and ash. Coastal lands have soils developed in calcareous sands and other biogenic sediments (coral and shell). Much of the steep upper slopes are prone to landslides, especially where vegetation has been removed or lost in catastrophic events such as hurricanes. Periodic landslides transform slope contours and vegetation patterns.

Vegetation in the upland areas is primarily climax montane rainforest. The lower and gentler slopes are in lowland rainforest, but have seen centuries of forest clearance for traditional Samoan cultivation. This zone has been described as disturbed forest (Atlas 1981). The littoral zone includes coconut, pandanus, creeping vines, grasses, succulent herbs, and a variety of economic and ornamental plants, many of them of recent introduction. As detailed below, a variety of these plants have medicinal value and are used by Samoans. Thus, contemporary vegetation across the National Park in this area is a mosaic of anthropogenic and native (including climax) floral elements.

Animals in the park lands on Tutuila include a variety of seabirds, domestic and feral animals (e.g., pigs, dogs), a

variety of native birds, and the flying fox. Undisturbed coastal and upland forest zones are important habitats for these animals.

2. Ofu and Ta`u Units (Manu`a). The Manu`a Islands of Ofu, Olosega, and Ta`u lie approximately 100 km to the east of Tutuila. The three islands are closely adjacent and form an intervisible cluster. These are the smallest and geologically youngest of the Samoan Islands. Their topography is steep and coastal lands are narrow. Coastlines are predominantly rocky with a limited number of fringing reefs. Slopes are unstable with erosional fans and scree slopes common where the narrow coastal plain meets the steep volcanic slopes (Hunt and Kirch 1988:156). The narrow coastal plains--the locations for human settlement--are geomorphically unstable with mass wasting from steep slopes and removal and redeposition of sediments by high energy surf during tropical storms and hurricanes (Hunt and Kirch 1988:156). These are significant factors in the evolution of landforms, vegetation patterns, and ancient and contemporary human settlement in the Manu`a Islands.

The Island of Ofu is small (3.4 km²), but reaches an elevation of 638 meters. The island is steep and dramatically beautiful; only about nine percent of the island has slopes less than 30 degrees. The National Park unit on Ofu extends along the southern coast, including a strip of coastal land (the seaward side of the road), the southern portion of Sunuitao Peak, and the reef. Much of the Park area is locally known as To`aga. The coastal strip is comprised of a geologically-recent sandy substrate, and some volcanic rock and its derived soil. Vegetation is typical of the littoral zone, including coconut, pandanus, creeping vines, grasses, succulent herbs, and some economic and ornamental plants. A significant variety of these plants are used for medicinal purposes by villagers from Ofu and Olosega, as detailed below. The contemporary vegetation of the coastal lands in the Ofu unit is a mixture of anthropogenic and native strand floral elements.

Animals in the park lands on Ofu include a variety of seabirds, domestic and feral animals (e.g., pigs, dogs), a variety of native land and seabirds, rats, and the flying fox. Birds commonly seen in National Park unit on Ofu are White-collared Kingfishers, ti`otala (*Halcyon chloris manuae*, an endemic subspecies to Manu`a), the Banded Rail, ve`a (*Gallirallus philippensis*), the Wattled Honeycreeper, iao (*Foulehaio carunculata*), and the Polynesian Starling, mitivao (*Aplonis tabuensis*) (Kirch 1993). Seabirds are also common residents of the Ofu unit, including the graceful tava`e, White-Tailed Tropic bird (*Phaethon lepturus*) and the seasonal migrant, tuli or Golden Plover (*Pluvialis dominica fulva*).

The marine component of the Ofu unit comprises a vital fringing reef, rich in marine resources and used for traditional Samoan gathering and fishing. A diversity of shellfish inhabit the reef. Bivalves such as *Periglypta reticulata*, *Tridacna maxima*, *Hippopus hippopus*, and *Asaphis violascens*, and gastropods such as *Trochus maculatus*, *Turbo setosus*, *Nerita* spp., *Cypraea* spp., *Drupa* spp., *Thais armigera*, and *Conus* spp. are abundant (Kirch 1993). Many of these shellfish taxa have been important sources of protein, as shown by the analysis of the excavated archaeological faunal remains from To`aga, adjacent to the National Park area of Ofu Island (Nagaoka 1993). Spiny lobsters (*Panulirus* sp.), sea slugs (holothurians), sea urchins (echinoderms), octopus, and many edible seaweeds are also significant resources on the reef at To`aga. Numerous taxa of inshore fishes inhabit the reef area as well. Among the fish commonly caught by villagers are jacks (*Caranx* spp.), parrot fish (*Scarus* spp.), wrasses (*Labridae*), and acanthurids (Kirch 1993).

The Island of Ta`u is the largest (28.5 km²), of the Manu`a Group, and its broad mountain (Lata) reaches an elevation of 965 meters. Ta`u is geologically the youngest island in Manu`a, as well as in Samoa as a whole. The island has comparatively broad slopes, with about 41 percent of the island's land sloping less than 30 degrees. The National Park unit on Ta`u covers a substantial southeastern portion of the island (from Fatulele Point to Saua on the coast), including interior lands (Lata Mountain), the ancient caldera (formed in part by Liu Bench), southeastern shorelines and coastal flats, and near offshore marine environments.

The coastal lands (at Saua and Luama`a) have a geologically-recent sandy substrate, with some volcanic rock and its derived soil. The coastal geomorphology has been shaped by recent sea level changes and by catastrophic events, such as high surf associated with tropical storms and hurricanes. Large coral slabs form a deposit over much of the coastal lands near Saua, attesting to a dynamic geomorphic history over the recent past.

The Ta`u unit is covered largely in rainforest, but at present is under some traditional cultivation (eastern coastal lands). The soils are well-drained and derived from parent materials of volcanic rock and ash. Coastal lands have excessively well drained soils derived from calcareous (beach) sand and biogenic detritus (coral and shell).

Vegetation in the Ta`u unit is primarily climax rainforest. The zones for this rainforest range from cloud forest (Lata Mountain), lowland and montane vegetation (on the steeper slopes), and disturbed forest zones (Liu Bench, where centuries of agriculture has altered the vegetation). Coastal lands today include traditional Samoan cultivation (Saua and Luama`a areas),

and littoral vegetation including natural and anthropogenic elements.

As elsewhere in Samoa, animals in the park lands on Ta`u include nesting seabirds, domestic and feral animals (especially pigs), a diversity of native landbirds, and the flying fox. The vast interior forested interior of Ta`u undoubtedly provides a critical habitat for nesting seabirds and native landbirds. Although not as well documented, we would expect birds similar to those observed on Ofu (Kirch 1993) to be found on Ta`u.