

Threats to Pacific Island biodiversity and biodiversity conservation in the Pacific Islands

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Introduction

The rich biodiversity of the Pacific Islands is seriously threatened. Many ecosystems are being degraded and reduced in size and many terrestrial, freshwater and marine plants and animals are rare, endangered or depleted (Thaman 1988, 1999a). This paper discusses some of the more serious threats, particularly those that can be addressed at the community level. Although all of these threats, many of which are interrelated, are of serious concern in varying degrees throughout the Pacific, it is beyond the scope of this paper to discuss each of them individually. However, if our efforts to mainstream biodiversity conservation are to be successful, these threats need to be systematically addressed, at a range of different levels (government, school systems, local communities), by different agencies (NGOs, private enterprises, funding/aid agencies) and in a range of different forums.

The threats are considered in two groups: major direct threats to biodiversity, and major social, institutional and infrastructural threats.

Major direct threats to biodiversity

- High frequency of extreme events/natural disasters
- Breakdown of species composition and nutritional structure of terrestrial, freshwater and marine ecosystems
- Upland and inland deforestation and forest degradation
- Coastal and mangrove deforestation and degradation
- Degradation of freshwater resources and ecosystems
- Agricultural and food system breakdowns
- Overgrazing and degradation of biodiversity by domestic and feral animals
- Alien invasive plants and animals
- Pest and disease infestations and epidemics
- Destruction and degradation of marine ecosystems
- Overuse of terrestrial plant and animal resources
- Unsustainable use of marine resources

Major social institutional and infrastructural threats

- Loss of traditional ethnobiological knowledge
- Free trade and globalisation

High frequency of extreme events/natural disasters

Tropical cyclones, high winds, tornadoes, floods, tidal waves, king tides, volcanic eruptions, earthquakes, tsunamis/seismic sea waves, prolonged droughts, and El Niño and La Niña events all have a dramatic impact on the biodiversity of islands, particularly small islands that have small populations of different species of terrestrial, freshwater and marine plants and animals, limited areas of important ecosystems and limited potential for replacement by over-ocean dispersal. Recent increases in the frequency of extreme events have caused widespread habitat/ecosystem destruction and degradation and the depletion or extinction of rare or endangered species. Temporary increases or falls in sea level and sea-surface temperatures have been shown to have extremely serious impacts on coral reefs, producing widespread reef bleaching, the death of corals and breakdown in coral reef and marine ecosystems.

Breakdown of species composition and nutritional structure of terrestrial, freshwater and marine ecosystems

In many Pacific island ecosystems there is increasing evidence of the loss or endangerment of important 'keystone' species such as insects, spiders, birds, fruit bats, crabs, sharks, and parrotfish. These species serve as pollinators, dispersal agents, decomposers, top predators or sand producers, and play critical roles in maintaining the balance within, and the healthy functioning of, ecosystems. Many are endemic species that have co-evolved over many thousands or millions of years in the island ecosystem and are highly specialized and highly co-dependent. The loss of species can lead to the breakdown of fragile interspecies relationships, entire food chains and reproductive cycles, to the collapse of entire ecosystems and of local subsistence economies that depend on terrestrial and marine biodiversity. For example, the loss of pollinators can lead to the eventual extinction of the pollinator dependent plants which in turn can lead to the population reduction or extinction of animals that depend on plants or on the animals that feed on plants. Similarly, the decrease in parrotfish which are responsible for the production of a high proportion of sand and marine sediments, can lead to the loss of beaches and accelerated coastal erosion and the breakdown in coastal and lagoon ecosystems.

Upland and inland deforestation and forest degradation

Many forest ecosystems, indigenous and introduced trees, particularly on small islands, are degraded, endangered, scarce or in need of protection. Primary or relatively undisturbed inland

indigenous lowland, slope, montane or cloud forest, is rare, endangered or absent on most populated small islands. Deforestation of watersheds throughout the Pacific is the main cause of increasing flooding and sedimentation of rivers and streams and increasing sediment loads are destroying or degrading many nearshore coral reefs and other coastal ecosystems and their biodiversity. Forests are the main habitat for the great majority of terrestrial plants, animals and insects. The vast majority of unique endemic species live almost exclusively in indigenous inland and upland forests. Where forests have been destroyed, degraded or reduced, the plants, animals, and human cultures that depend on them have also disappeared.

Some form of protected status is required for most inland forest areas particularly on smaller islands where there is very limited inland forest cover. In some areas indigenous reforestation and forest restoration efforts may be required. Where logging must take place, this should be restricted to systems of sustainable rotational logging. Such programs should be promoted at both national and community levels, and should be complemented by awareness programs that stress the critical ecological functions of forest ecosystems as reservoirs of biodiversity on which the economy and culture of Pacific Island nations and societies depend. Most local communities clearly understand the ecological importance of forests and, given the appropriate support, are willing to give some form of protection to remaining areas of forest and small tree groves on all islands.

Coastal and mangrove deforestation and degradation

Coastal deforestation, the degradation of coastal and mangrove forests and the loss of coastal and mangrove biodiversity is a serious problem throughout the Pacific. The major causes are conversion or reclamation of coastal vegetation and mangroves for other, often agricultural, urban or industrial uses. On many smaller islands, and in some coastal areas on larger islands, thousands of years of coastal habitation and the selective use of coastal and mangrove species for firewood, construction and boat building materials, for woodcarving, medicines and other purposes, and widespread destruction during World War II, have led to either the total or selective removal of many of the more culturally valuable species.

The protection of coastal and mangrove forests is considered a priority for most governments and local communities. This is particularly important because these forests protect inland garden areas and coastal settlements from cyclone damage, storm surge, saltwater/tidal incursion, coastal erosion and salt spray and the threat posed by global warming and associated sea-level rise. These ecosystems are also important habitats for a wide range of culturally and economically important plants and animals and, in the case of mangroves, of a very wide range of marine organisms. When coastal forests and vegetation are removed or degraded coastal erosion is accelerated, salt water incursion and salt spray damage to crops and property increases, and coastal and mangrove plant communities are threatened.

Degradation of freshwater resources and ecosystems

The pollution, overuse and diversion or drainage of rivers, swamps, other surface water resources and groundwater sources is a serious problem in many areas. Major pollutants include domestic waste and sewage, animal waste, agricultural waste, including fertilizer and pesticide runoff and leachate, and industrial waste including waste from timber milling and mining. There are also the problems of siltation of rivers, reservoirs and drainage ditches, and the incursion of saltwater into freshwater lenses on atolls, other small islands and coastal areas throughout the Pacific Islands.

Fresh water is, perhaps, the most basic and important resource for ensuring the continuing health of both human communities and the non-human terrestrial and freshwater biological communities. Freshwater ecosystems and resources in general must be among the most highly threatened ecosystems in the Pacific, particularly on small islands, given their highly restricted distribution, sensitivity to disruption, attractiveness to human development, and the high dependence of human communities on water. The problem is exacerbated in times of prolonged drought when drought-sensitive plants and animals decline in numbers or become locally extinct.

Legislation, public education, water conservation and protection of freshwater resources are urgently required to prevent further degradation. On some small drier islands where local demand for water is great, the development of improved rainwater catchment systems is a priority, and appropriate desalination technologies should be considered.

Agricultural and food system breakdown

In many areas of the Pacific, agricultural and food systems are being rapidly degraded, and their biodiversity lost. Of particular concern is the breakdown of traditional shifting agro-forestry systems in which a wide range of fruit trees and other culturally and ecologically valuable trees, plants and wild and domesticated animal life were deliberately protected within a matrix of ground and tree crops and various stages of fallow vegetation.

Local biodiversity is the original source of almost all food for most Pacific Islanders. Traditionally, Pacific Island peoples were among the most well nourished and healthy people on Earth. Serious malnutrition, diabetes and cardiovascular disease were rare, and people had good teeth. Today, a large percentage of Pacific Islanders, mainly in urban areas, are among the most poorly nourished people in the world. They have extremely high rates of iron-deficiency anemia, vitamin-A deficiency, obesity, dental disease and nutrition-related non-communicable diseases, such as diabetes, hyperuricemia and gout, hypertension, cardiovascular disease and some forms of cancer, such as stomach and bowel cancer. The main causal factor associated with this drastic health transformation is the abandonment of the traditional diet coupled with a more sedentary lifestyle and widespread consumption of tobacco.

Overgrazing and degradation by domestic and feral animals

The introduction of domestic grazing animals, including beef and dairy cattle, horses and goats has led to the clearance of extensive areas of forest and shifting cultivation lands for livestock schemes. The uncontrolled husbandry of pigs has had a significant impact on the flora and fauna around village areas. Free ranging pigs root up trees and seedlings and are a serious threat to ground nesting birds, a range of terrestrial invertebrates and to herbaceous under story plants. Uncontrolled grazing by cattle has led to accelerated soil erosion and goats have been responsible for the almost total devegetation of some small offshore islands.

Improved animal husbandry in the form of improved fencing and/or tethering of animals and rotational grazing is required to minimize habitat destruction, soil erosion and destruction of trees, crops, and wild flora and fauna by domestic animals. Local communities need to be persuaded to remove goats from small uninhabited islands and to pen pigs around villages and on small islands.

Alien invasive plants and animals

The island flora and fauna have evolved in isolation, have become very specialized and have, in many cases, lost their defence and dispersal mechanisms. As a result, they are normally unable to compete with organisms from continental areas. The threat in the marine environment is perhaps just as great, with thousands of new, often microscopic, alien marine organisms being introduced every year, mainly in ballast water. Such organisms could lead to algal blooms and the serious disruption in marine food chains.

The most destructive alien plants and animals include:

- the brown tree snake (*Boiga irregularis*), which has brought to extinction almost all of the indigenous birds and has endangered the fruit bats of Guam (Rodda and Fritts 1993);
- the mongoose, cats and rats, which have eliminated many ground nesting birds and amphibians from some islands;
- a number of extremely invasive weeds, such as *Miconia calvescens*, known as the green cancer, which has invaded extensive areas of native vegetation in Tahiti (CGAPS c. 1997), and *Wedelia biflora*, which has invaded thousands of hectares in Pohnpei and coastal and mangrove areas in Fiji, Niue and Marshall Islands (Thaman 1999b);
- biological control agents, such as the carnivorous snail, *Euglandina rosea*, which was introduced to control another introduction, the giant African snail (*Achatina fulica*), but has brought to extinction most of the many endemic partulid land snails of the island of Moorea in the Society Islands;
- insects, particularly ants, which have endangered bird species and a wide range of endemic or indigenous insects and other invertebrates that seem

to have almost no defences against alien ants, especially in Hawai'i, which had no indigenous ants! (Wetterer *et al.* 1998; CGAPS c. 1997).

Regional and national protocols need to be developed to control the introduction, spread and impact of alien invasive plants and animals. International agencies, such as the South Pacific Regional Environment Programme (SPREP), the Secretariat of the Pacific Community (SPC) and The University of the South Pacific (USP) should cooperate to assist Pacific Island countries in the development of Alien Species Action Plans (ASAP) along the lines of that adopted in Hawaii, which is the most dramatic example of the negative impact that alien species can have on the indigenous island flora and fauna (CGAPS c. 1997). There is also a need for a regional data base on invasive and potentially invasive species and the strengthening of regional and national quarantine systems in the Pacific. Perhaps most important is the need for a comprehensive public education program to make policy makers, the general public and local communities aware of the threat posed by this 'silent invasion' by alien organisms.

Pest and disease infestations and epidemics

Epidemic pest and disease infestations have a very negative impact on biodiversity, especially where monocropping, large-scale livestock operations and indiscriminate use of pesticides are concerned. Although these may be viewed as cultural issues, they may in fact be related to natural phenomena.

In Papua New Guinea, Solomon Islands and Samoa the taro leaf blight (*Phytophthora colocasiae*) has almost eliminated the cultivation of this important staple and commercial crop. Similarly, the Alomae and Bobone virus syndrome in Papua New Guinea and Solomon Islands, and Pithium corm rot in the Cook Islands, Hawaii and Samoa are very serious diseases to *Colocasia* taro. In Kiribati, the Papuana taro beetle has made it very difficult to practice traditional pit excavation planting of giant swamp (*Cyrtosperma*) taro, the only major staple root crop on many low-lying atolls. Banana cultivation, primarily for export, but also as an extremely important local staple and fruit crop, is plagued by bunchy-top virus and black leaf-streak fungus (*Mycosphaerella* spp.) as well as by the banana scab moth and root nematodes which have severely limited production in Tonga, Fiji, Samoa, and the Cook Islands. Insect infestations have also led to the cessation of large-scale rice production in Fiji and Solomon Islands.

Integrated Pest Management (IPM) must be implemented to control pests and diseases with minimal use of pesticides. Regional, national and inter-island systems for quarantine and fumigation need to be strengthened. There is also a need to return to polycultural farming systems in which there is less dependence on monocropping, often depending on only one high-yielding cultivar.

Destruction and degradation of marine ecosystems

The destruction and degradation of productive marine ecosystems and disruption or change in the dynamics of marine ecosystems

constitute major threats to biodiversity. This includes the destruction and degradation of coastal nearshore intertidal areas, seagrass beds, coral reefs, lagoons and reef passes as a result of reclamation or conversion to other uses, pollution, sedimentation and misuse. The destruction and degradation of marine habitats, such as the reclamation of intertidal areas, destruction of seagrass beds, filling in of lagoons or the construction of causeways in reef passes between atoll islets that change current patterns, alongshore deposition and the tidal flushing of lagoons and upwelling in nearshore waters can bring about collapses of entire ecosystems.

Major development proposals in coastal and marine ecosystems should be subject to careful environmental impact assessment, and development approval should be made subject to the incorporation of biodiversity conservation measures. Developers and the general public need to be made aware of the dynamic nature and fragility of the marine environment and the options available to minimise the destruction and degradation of productive marine ecosystems

Overuse of plant and animals resources

Overuse/overexploitation of terrestrial plant and animal resources without restoration or allowing target populations to recover, or without systematic replanting in the case of trees and other plant resources, is a major threat to biodiversity and the well being of Pacific island communities. Continual hunting and over harvest of terrestrial animal resources, such as a wide range of birds and their eggs, fruit bats, coconut crabs and large hermit crabs has been responsible for the severe reduction or disappearance of these animals on many islands. Major uses that have led to the disappearance of trees and other plant resources at the community level include firewood, medicines, dyes, construction and canoe or boat building.

There is a priority need to identify those terrestrial animals and plants that are overused, threatened or have disappeared and to initiate some form of protection, re-establishment or, in some cases, re-introduction at the local community level. In most island groups there is also a need for the establishment of national and local programs for the collection of desired plant species, the establishment of nurseries and the propagation and replanting of a wide range of trees and other useful plants that are now scarce or have disappeared at the village level.

Unsustainable use of marine resources

This includes the overexploitation of fisheries resources (seaweeds, finfish, bêche-de-mer, crabs and lobsters, shellfish, corals and other marine invertebrates) formerly reserved for local subsistence consumption, for rapidly expanding local and export commercial production. Overexploitation is often associated with the use of more efficient and modern fishing technologies (better motorised boats, improved spear guns and line fishing methods, improved preservation/refrigeration and distribution, more efficient nets, night and SCUBA or hookah spear fishing). Increasing human populations, particularly near urban areas, have also put greater pressure on limited marine resources.

Species most commonly mentioned by local communities as being rare, in short supply or locally extinct (extirpated) include sea turtles, large demersal finfish such as the humphead or Napoleon wrasse, large groupers and the bumphead parrotfish, large sharks, giant clams, triton shells and a number of other shellfish, most species of bêche-de-mer, a number of crab species, corals and some species of seaweed. The population depletion or elimination of some of these species will not only have serious cultural, nutritional and economic implications, but may also have very serious effects on the ecosystems in which they live. For example, the elimination of some species that are important top predators could affect marine food chains and have very serious effects on other species.

Regional, national and local community-based initiatives to identify species or groups of species in need of protection could be introduced. At the local community level, this could take the forms of moratoria on the exploitation of some species, bans on commercial exploitation, limits on total catch, size restrictions, seasonal restrictions, gear restrictions, or protection of species within restricted areas. Successful programs that have taken this approach include the development of fisheries management and monitoring plans by the Fiji Locally Managed Marine Areas network and the AusAID-funded fisheries management program in Samoa.

Loss of traditional ethnobiological knowledge

Many authorities believe that the loss of traditional knowledge about the uses, beliefs, management systems and language related to biodiversity could be one of the most serious obstacles to successful biodiversity conservation in the Pacific islands (Thaman 1988, 1999a). Site-based biodiversity conservation will be problematic if the local people can not marry traditional conservation strategies with modern scientific models as part of co-management systems. If local people no longer know the local names, uses and management systems for their biodiversity, the chances are that they will not place a priority on its preservation. At the same time the modern scientific community is bemoaning the lack of financial support for the training of good young taxonomists. Many of the best traditional Pacific island scientists and taxonomists are aged or have died and are not being replaced by the younger generation which is less interested in the natural world. Traditional ethnobiological information accumulated over thousands of years in close contact with the island environment dies with them.

Preservation of traditional ethnobiological knowledge and its application to biodiversity conservation in the Pacific Islands needs to be given priority. Scholarships for study and training incorporating traditional and modern modes should be made available at university and vocational levels. Funding is required to record and disseminate traditional knowledge so that it can be used as a basis for both biodiversity conservation and the development of curriculum materials for local schools. There is also a critical need to ensure that all researchers are required to provide local host communities with copies of all survey results,

hopefully also in the vernacular, to local host communities where such studies are conducted. National legislation should also require that such information be provided to host communities and lodged with appropriate local repositories.

Free trade and globalization

The free trade of biodiversity, particularly the unregulated trade in threatened species and the illegal trade in species listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a serious threat. Evidence from Southeast Asia shows that the unregulated and illegal trade in threatened species has led to the economic extinction and endangerment of a wide range of terrestrial and marine species and the breakdown in ecosystem function. The unrestricted free trade of important timber species harvested using unsustainable logging models, the unrestricted export of sandalwood from a number of countries, the uncontrolled harvest and sale of shark fin and other shark products, bêche-de-mer, giant clam, and live reef fish have put great pressure on these resources and the ecosystems in which they live. The increasing trade in ornamental marine aquarium species and living corals, if not controlled, will, undoubtedly, also lead to the endangerment of some species and ecosystem degradation. Because of the relative poverty (in cash terms) and limited opportunities for cash income in most Pacific rural and outer island areas, the uncontrolled exploitation of such plants and animals constitutes one of the greatest threats to biodiversity conservation in the region.

All countries should become party to the Convention on Biological Diversity (1992) and incorporate into national Biodiversity Strategies and Action Plans controls to regulate trade in endangered plants and animals. All countries should become party to CITES and strongly enforce its provisions within the region. Private industry should be strongly encouraged to promote sustainable timber logging and harvest of marine ornamentals through association with organizations such as Traffic International, The Forest Stewardship Council and the Marine Aquarium Council. There is also the need, within the region, to educate local communities about the very negative impacts that have occurred in areas such as Southeast Asia as a result of uncontrolled trade in such products, and the options that are available to them for promoting the conservation and sustainable harvest of terrestrial and marine export products.

Conclusion

Most of these threats are of global, international, national and local concern, and can be addressed, in some way, at all levels through mainstreaming. Some, however, like the depletion of stratospheric ozone, international trade of endangered, or potentially invasive, plants and animals, pest and disease infestations and epidemics, are best dealt with regionally or internationally, whereas the protection of endangered or threatened species and ecosystems are, perhaps, best dealt with at the national or community levels. Similarly, many of these threats overlap or feed into each other, and if not addressed in some way, could lead to a dangerous negative synergistic effect and the collapse of entire ecosystems or biological communities and the countries and cultures that depend on them. Conversely, if a number of threats are addressed simultaneously, the result could be very positively synergistic and lead to significant gains in the mainstreaming of conservation, the sustainable use of biodiversity and alleviation of poverty in the Pacific Islands.

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