LAND, PLANTS, ANIMALS AND PEOPLE: COMMUNITY-BASED BIODIVERSITY CONSERVATION (CBBC) AS A BASIS FOR ECOLOGICAL, CULTURAL AND ECONOMIC SURVIVAL IN THE PACIFIC ISLANDS

R. R. Thaman[1]

1 INTRODUCTION

This paper suggests that this terrestrial and marine biodiversity inheritance constitutes the foundation upon which rests the survival of the relatively benign and peaceful ways of life in the Pacific ("Peaceful") Ocean. It is stressed that this inheritance, including traditional knowledge concerning it, is endangered by modern development and education, and that if it is not maintained or strengthened, the cultures, economies and rich biodiversity inheritances of Pacific societies WILL NOT SURVIVE.

The increasing realisation of the importance of biodiversity conservation at the international level is attested to by the signing of the Convention on Biological Diversity (CBD) at the United Nations Conference on Environment, the "Earth Summit". held in Rio de Janeiro in June last year. The CBD, which provides a framework for the protection of both terrestrial and marine biodiversity, which was signed by nine Pacific island countries, is seen as particularly important to areas of the Pacific, such as New Caledonia, that have "globally significant areas of biological diversity." The implementation of CBD will be facilitated by the South Pacific Regional Environment (SPREP)-based $US10.5 million South Pacific Biodiversity Conservation Program (SPBCP), funded by the Global Environment Facility and Australia. The importance of the protection of small island ecosystems is also mentioned in Agenda 21, the UNCED action plan for the next decade leading up to the 21st Century.

However, whereas the predominant focus for most rich-country motivated biodiversity preservation includes uniqueness or endemism, scientific importance, importance as potential gene pools for plant breeding, medicinal discoveries or other technical breakthroughs for the benefit of humankind, export or touristic potential, or the ecological benefits of biodiversity and ecosystem preservation, for most Pacific Island societies, the focus of biodiversity preservation should be its central role as the basis for ecological, cultural and economic survival of local communities. Although there are undoubtedly new technologies, types of "development" and some new plant and animal species that could enhance biodiversity and the quality of life in all areas of the Pacific, the basis for survival will remain the "land" and its wild and domesticated plants and animals that have served Pacific societies for millennia.

[1]. Professor of Pacific Islands Biogeography, Geography Department, School of Social and Economic Development (SSED), The University of the South Pacific (USP), Suva, Fiji.

In terms of the implementation of strategies for biodiversity conservation, it is argued that, in terms of cost- and biodiversity-conservation effectiveness (measured in terms of the number of endangered and ecologically and culturally important ecosystems and taxa that are protected or increase in numbers), AND in terms of maintaining the cultural and spiritual link with biodiversity, the major effort should be placed on conservation of biodiversity at the local community or landowner level, through the implementation of multi-ecosystem "community-based biodiversity conservation" (CBBC). This is seen as critical for the following reasons: 1) because of the fragmented and isolated nature of most island groups and their constituent communities, larger national- or island-level conservation area development would benefit only a small minority of the people in most Pacific countries; and, 2) because most land use or conservation decisions are made and implemented at the landowner or community level and not at the national or regional level, the success or failure of most conservation initiatives rests with the landowners and whether or not they clearly see the benefits of biodiversity preservation. This is not to suggest that national initiatives for the establishment of conservation areas are not also a priority. Finally, it is argued that for community or national biodiversity conservation programmes to be successful, a major component, in terms of both funding and personnel, must be devoted to public education with respect to the importance of biodiversity to cultural survival and sustainable development, and how it can be conserved or enhanced at the community, national, regional and global levels.

In pursuing this theme, the paper will include: 1) a brief examination of what the emerging concept of biodiversity and biodiversity conservation should or could mean in the context of the Pacific Islands; 2) the ecological, cultural and economic importance of biodiversity to Pacific societies; 3) an examination of how modern ecologically- and biodiversity-blind development has increasingly eroded both the biodiversity inheritances and traditions of the islands; and, finally 4) some recommendations which could facilitate the implementation of Community-Based Biodiversity Conservation (CBBC) as a basis for culturally and environmentally sustainable development in the Pacific Islands.

2 BIODIVERSITY AND BIODIVERSITY CONSERVATION IN THE CONTEXT OF A CHANGING PACIFIC

For most Pacific Island societies, "biodiversity" is not just a matter of scientific, economic (in monetary terms), recreational or ecological value. It is a capital inheritance, which has been passed on, relatively intact or in some cases enhanced, by past generations to current and future generations of Pacific Islanders. Biodiversity is not income that should be spent or destroyed. It is the "capital" needed for development and maintenance of Pacific societies and upon which "subsistence affluence" and almost all "income" (both cash and non-cash) is derived. It is the foundation of their culture.

When asked which aspects of their cultural heritage Pacific people value most, among the most commonly mentioned are myths, legends, songs, dances, traditional feasts, seafood, leis and garlands, kava, betelnut, whale's teeth, shell money, fine mats, tapa cloth, their seafaring and navigational skills, yam or taro gardens or their own home island or village setting to which they

often intend to ultimately return. The importance of unselfishly sharing these traditions with family and community is, of course, also stressed as being central to the "Pacific Way". Most of these "valued things" have one thing in common: they depend on, are derived from, or focus on THE LAND (including water and ocean) and its constituent plants and animals . . . increasingly referred to as "biodiversity", the conservation of which has become a *cause celebre* of the international environmental and development community.

Whereas the predominant focus for most rich-country motivated biodiversity preservation includes uniqueness or endemism, scientific importance, importance as potential gene pools for plant breeding, medicinal discoveries or other technical breakthroughs for the benefit of humankind, export or touristic potential, or the ecological benefits of biodiversity and ecosystem preservation, for most Pacific Island societies, the focus of biodiversity preservation in the Pacific Islands should be its central role as the basis for ecological, cultural and economic survival of local communities. Particular stress is placed on the fact that for semi-subsistence societies, 25 to 90% of the real income of rural peoples is in the form of non-cash income derived from local terrestrial and marine plant and animal resources. Moreover, this income is relatively unaffected by inflation and deterioration in terms of trade which has historically ALWAYS made imported goods increase in cost more rapidly than our wages in the cash economy or what we receive in return for our exports overseas (e.g., cash crops, fish, timber, minerals, etc).

Moreover, if we are indeed worried about cultural survival and sustainability in some of the biologically-poor areas on earth, the focus of biodiversity conservation programmes must include not only native and endemic (unique) terrestrial and marine species, or larger "charismatic megafauna", such as the dugong, sea turtles, whales, rare birds, bird-wing butterflies, etc., but must also include the preservation of endangered or ecologically and culturally important ubiquitous indigenous and exotic (non-indigenous), and wild AND domesticated, species or varieties. This is seen as particularly critical in the context of smaller islands, such as the atolls, which have limited ecosystem diversity and FEW IF ANY ENDEMIC PLANTS OR ANIMALS OF GLOBAL SCIENTIFIC INTEREST, but where the protection of often ubiquitous plants and animals, both indigenous and exotic, must be given at least equal priority as the protection of rare, highly endemic biota of larger islands, because it is their ONLY biota. For example, a large proportion of the few indigenous plant species of Nauru (28 of 55) and Kiribati (40 of 83) are severely restricted in distribution, endangered or possibly extinct due to overexploitation and habitat modification (Thaman 1992). In other words, the biodiversity of these small islands is much more endangered and much more in need of management than that of the larger islands in the western Pacific.

3 PACIFIC ISLAND BIODIVERSITY

Biodiversity can be assessed in terms of both the diversity of different types of ecosystems or in terms of the overall diversity of plants and animals in a given place. Although there is a wealth of biodiversity in the Pacific Islands, there is great diversity **and** disparity in the biological inheritances of different countries at the island and ecosystem levels. The larger islands of western Melanesia have the greatest ecosystem diversity and among the richest floras and faunas in the world, whereas

the smaller low-lying atolls of the eastern Pacific have the lowest ecosystem diversity and among the most impoverished terrestrial floras and faunas. In terms of marine biota the disparity is not so great, although there is still an attenuation of species from west to east (Stoddart 1992).

In terms of ecosystem diversity, a survey by Dahl (1980) of characteristic ecosystems, to determine their state of endangerment and to make proposals for their conservation, identified over 70 ecosystem or biome types found in the Pacific Islands. These included: 1) terrestrial or freshwater ecosystems such as tropical lowland and upland forests, swamp and riverine forests, mangrove and coastal beach forest, woodlands and savannas, meadows, scrublands, deserts, marshes, rivers, streams and lakes; 2) marine ecosystems such as algal and seagrass beds, beaches, a range of reef and lagoon types, estuaries, offshore slopes, terraces, shelfs, canyons, sea mounts and abyssal plains; plus, 3) what seem to be subsets of these, such as seabird rookeries, sea turtle nesting areas and upwelling systems in the ocean. These are further broken down into approximately 600 individual ecosystems based on different island types, substrates, slope exposures, climate, etc.

SPREP, with support from The Nature Conservancy (TNC), the United States Agency for International Development (USAID), the US Fish and Wildlife Service (USFWS), the East-West Center (EWC) and the Worldwide Fund for Nature (WWF) has been working on a refinement of the Dahl system which can be used to inventory ecosystems on a regional, national and island scale, as a basis for prioritising biodiversity conservation action.

Although both systems provide excellent bases for systematic regional and national inventories of ecosystems and biodiversity and their endangerment status, the predominant emphasis still seems to be on identifying systems that can be set aside for nature conservation rather than on the preservation of biodiversity so that Pacific peoples can continue to use it, hopefully on a sustainable basis. There is, thus, a need for a simpler, more functional ecosystem classification system, which could be used at the community or landowner level, and in schools in the region, to promote community-based biodiversity conservation (CBBC).

Such a system, which attempts to incorporate most of the major ecosystems of both the Dahl and SPREP systems, is shown systematically in Appendix I. The utility or advantage of such a classification system is that it: 1) includes most of the major resource-use zones, in both the traditional (e.g., primary forest, shifting agricultural land, mangroves, strand forest, rivers, houseyard gardens, tidal flats, lagoons, etc.) and modern (e.g., island-shelf fishery, plantations, grazing land, plantation forest, etc.) contexts; 2) roughly corresponds to local classification systems, which would have distinct vernacular terms for each resource-use zone; 3) identifies ecosystems types or resource use zones which have relatively distinct biological communities in terms of habitat, ecological niches, species diversity, and the degree of human modification and endangerment status; and 4) identifies ecosystems which can all be managed by local communities themselves to protect, conserve or enhance the constituent biological resources as part of a multi-ecosystem community-based biodiversity conservation (CBBC) strategy.

To truly appreciate what biodiversity really means to Pacific societies, it is useful to identify the main classes or categories of taxa that constitute the biodiversity of each ecosystem, and which

could be protected a part of community-based biodiversity conservation (CBBC) initiatives. An attempt to do this is shown in Table 1. There are undoubtedly other classes, sub-classes or types of biological resources, or more "scientific" ways of classifying (e.g., gymnosperms and angiosperms). The system presented is only a first attempt at providing a system that could be used at the community, school and policy-making levels to bring to people's attention both the diversity of biological resources found in "their" ecosystems, and its ecological and functional utility as a basis for sustainable development at the household, community, national and regional levels.

Table 1. Classes, sub-classes, specific types and the utility of terrestrial, freshwater and marine resources that constitute the pool of ecologically important and functionally useful biological resources of community-level ecosystems in the Pacific islands (Under "Utility", E, S and C = direct major Ecological, Subsistence or Commercial or Export utility to people at the community and national level in Melanesia, Polynesia or Micronesia, and e,s and c = minor or indirect ecological, subsistence or commercial/export importance, e.g. plankton is of indirect importance to commercial tuna fishing in terms of its importance in marine food chains; it must be stressed that taxa in some categories may also be harmful or have a negative impact on sustainable development, e.g. pathogenic virus or bacteria, malarial mosquitos, etc.)

Class	Sub-Classes	Specific Types	Utility
Lower Lifeforms		Bacteria	E,s,c
		Viruses	E,s,c
Plants	Indigenous	Phytoplankton	E,s,c
	Aboriginal Introductions	Algae	E,S,C
	Recent Introductions	Fungi	E,S,c
	Wild Plants	Mosses	E,s
	Domesticated Plants	Other Lower Plants	E,s,c
	Food Plants	Ferns	E,S,C
	Non-Food Plants	Herbs/Forbs	E,S,C
	Terrestrial	Grasses/Sedges	E,S,C
	Freshwater	Vines	E,S,C
	Marine	Shrubs	E,S,C
		Trees	E,C,C
Animals	Indigenous	Protozoa	E,s,c
	Aboriginal Introductions	Zooplankton	E,s,c
	Recent Introductions	Sponges	E,s,c

Wild Animals	Corals	E,S,c		
Domesticated Animals	Jellyfish		E,S,c	
Food Species	Worms		E,S,C	
Non-Food Species		Molluscs		E,S,C
Terrestrial		Insects	E,C,C	
Freshwater		Crustaceans		E,S,c
Marine	Echinoderms		E,S,C	
		Holothurians	E,s,c	
		Other Invertebrates	E,S,C	
		Fish		E,s,c
		Amphibians		E,S,C
		Reptiles		E,S,C
		Birds		E,S,C
		Non-Human Mammals		E,S,C
		Humans		E,S,C

From such a perspective, it can be seen that the "biodiversity" of almost all island ecosystems would be considerable, in some cases almost incomprehensible to a reductionist economist or "pure scientist" (but not to Pacific peoples and hopefully not to human biogeographers and their students). For example, preliminary analyses of the results of the our MacArthur Foundation survey of Ucunivanua Village in Fiji indicate that for shellfish alone there are over 70 different edible species, many of which are also main sources of cash income to the village. In North Ambrym, Vanuatu there are over 250 plant species considered to be useful in one way or another.

4 FUNCTIONAL UTILITY OF BIODIVERSITY TO PACIFIC SOCIETIES

As can be seen from the classification systems presented in Appendix I and Table 1, if one were to list all of the species, subspecies, forms, varieties, cultivars, races, breeds, provenances, etc. of wild and domesticated terrestrial and aquatic plants and animals from each class, subclass or type of biota in each ecosystem represented in a given community, island or Pacific Island country, the magnitude of biodiversity, even for a small atoll community, becomes all too apparent.

The true cultural importance AND diversity of "biodiversity" becomes even more astounding when we add an ethnobiological dimension to the equation and attempt to catalogue all the uses (the "bio-utility") of all taxa to a given community.

An attempt to do so for Pacific trees (Thaman and Clarke 1987) shows that trees serve at least twelve distinct ecological functions, have over 70 cultural uses (Table 2), and provide between 10 to as high as 75% of the real income and production of rural Pacific peoples. To replace these products with imported substitutes would either be impossible or too expensive. To eliminate these

trees would, thus, constitute a major ecological, cultural and economic disaster which would seriously undermine self-reliance and sustainability in the Pacific Islands.

Table 2. Ecological and cultural functions and uses of trees in the Pacific islands.

ECOLOGICAL

Shade	Soil Improvement	Animal/Plant Habitats
Erosion Control	Frost Protection	Flood/Runoff Control
Wind Protection	Wild Animal Food	Weed/Disease Control

CULTURAL/ECONOMIC

Timber(commercial)	Broom	Prop or Nurse Plants
Timber(subsistence)	Parcelisation/Wrapping	Staple foods
Fuelwood	Abrasive	Supplementary Foods
Boatbuilding(canoes)	Illumination/Torches	Wild/Snack/Emergency Foods
Sails	Insulation	
Tools	Decoration	Spices/Sauces
Weapons Hunting	Body Ornamentation	Teas/Coffee
Containers	Cordage/Lashing	Non-alcoholic Beverages
Woodcarving	Glues/Adhesives	Alcoholic Beverages
Handicrafts	Caulking	Stimulants
Fishing Equipment	Fibre/Fabric	Narcotics
Floats	Dyes	Masticants/Chewing Gum
Toys	Plaited Ware	Meat Tenderiser
Switch for Children/ Discipline	Hats	Preservatives
	Mats	Medicines
Brush/Paint Brush	Baskets	Aphrodisiacs
Musical Instruments	Commercial/Export Products	Fertility Control
Cages/Roosts		Abortifacients
Tannin	Ritual Exchange	Scents/Perfumes
Rubber	Poisons	Recreation
Oils	Insect Repellents	Magico-religious
Toothbrush	Deodorants	Totems
Toilet Paper	Embalming Corpses	Subjects of Mythology
Fire Making	Lovemaking Sites	Secret Meeting Sites

Source: Adapted from Thaman and Clarke 1987.

Similarly, an analysis of the ecological and cultural importance of 140 ubiquitous or locally important coastal and mangrove found from the continental islands of New Guinea and New Caledonia in the west to the smallest atolls, Easter Island and the Hawaiian islands in the east showed the "bio-utility" of these plant communities to be high wherever they are found (Thaman 1992).

In terms of the ecological utility of coastal plant resources, the most important functions include the provision of shade and animal and plant habitats, protection from wind, erosion, flood and saltwater incursion, land stabilisation, protection from the desiccating effects of salt spray, soil improvement and mulching, and as animal food or links in important terrestrial and marine food chains.

Of particular importance are mangrove ecosystems which contribute either directly or indirectly, through primary and secondary productivity, to the nutritional requirements of a high proportion of marine food species (Watling 1985). Research in Fiji has shown that over 60% of commercially important species live in mangroves or depend on mangrove food webs at some stage in their life cycle (Lal et al. 1983), whereas more rigorous research gives figures of 67% and 80% for eastern Australia and Florida (Watling 1985). Destruction and reclamation of mangroves have deleterious effects on fisheries yields, with studies in the Malacca Straits indicating that mangrove reclamation for industrial expansion led to a substantial drop in catches per effort (Khoo 1976), and Baines (1979) argues that mangrove removal can lead to offshore fisheries yield declines of 50 to 80%.

Similarly, *Pisonia grandis* is the most important seabird rookery species throughout the atoll Pacific. It is a species under which phosphate-rich, bird-guano derived soil and rock are found, and a very important pig feed in many parts of the Pacific. Where *Pisonia* has been removed, seabird populations decline and the location of schools of tuna based on the presence of seabird flocks becomes problematic for fishermen.

One of the most important ecological roles played by coastal plants is the protection of inland agricultural areas, non-coastal vegetation and fauna, settlements, and water supplies from saltwater spray and storm surge. Of particular value because of their remarkable tolerance to high levels of salinity, are plants with particularly high tolerance to salt spray and saline soils. Farmers throughout the Pacific purposely leave strand or mangrove forests intact seaside of their gardens, as they know that to remove these trees would make farming problematic. In Tonga, where coastal trees were removed to make boxes for shipping bannanas to New Zealand, it is now almost impossible to farm coastal allotments due to salt spray.

In terms of cultural utility, the analysis showed that there are some 75 different purpose/use categories for coastal plants, with the total frequency of usage for 140 plants being 1024, an average of 7.3 purpose/use categories per plant (Appendix II), ranging from no reported uses for only two

species to as many as 125 for the coconut, if distinct uses within categories (e.g., tools with distinct functions) are counted. Another 17 species have 20 or more reported uses, and 29 species have at least 7 uses each (Appendix III). Moreover, the list does not include the more strictly ecological functions of coastal plants, such as shade, protection from wind, sand and salt spray, erosion and flood control, coastal reclamation, animal and plant habitats, and soil improvement, all of importance to Pacific societies.

In terms of specific uses, the most widely reported uses are for medicine, general construction, body ornamentation, fuelwood, ceremony and ritual, cultivated or ornamental plants, toolmaking, food, boat or canoe making, dyes or pigments, magic and sorcery, fishing equipment, cordage and fibre, games or toys, perfumes and scenting coconut oil, fertiliser and mulching, woodcarving, weapons or traps, food parcelisation or wrapping, subjects of legends, mythology, songs, riddles, and proverbs, domesticated and wild animal feed, handicrafts, cooking equipment, clothing, fish poisons, items for export of local sale, adhesives or caulking, and musical instruments, all of which were reported for at least eleven species (Table 3). The analysis, however, is based on traditional uses, many of which have lapsed or are only employed in emergency, because modern technology has pre-empted them.

To provide greater detail on those plants of particular importance for specific purposes is beyond the scope of this paper, but can be found in my paper "Batiri kei Baravi: the Ethnobotany of Pacific Island Coastal Plants" (Thaman 1992). Examples are taken of only the medicinal, ceremonial or spiritual and body ornamentation or perfumery use of coastal plants.

Medicinal use was the most widespread with 113 species (81%) reportedly used medicinally, in at least one area of the Pacific. Of these 113 species, almost a quarter (27) are used medicinally for a variety of purposes, wherever they are found throughout the Pacific, as well as in southeast Asia the ancestral homeland of Pacific peoples (Perry and Metzger 1980).

The ceremonial and spiritual importance of plants, can not be overstated, with 40 species having ceremony or ritual importance, 29 used in magic and sorcery, and 18 featuring legends, mythology, songs, riddles, or proverbs. Those of more ceremonial importance, include species used in ceremonies or rituals associated with death, war and peace, human sacrifice and cannibalism, circumcision or coming of age, house or temple building, canoe making and launching, fishing, planting cycles, lovemaking, wavemaking or control of sea state, prayer sessions, as well as species serving as symbols or totems and mediums for communicating with spirits or gods or those planted in sacred groves or burial grounds. Others are associated with times of revelry or are used in the production of baskets, mats, and other articles reserved for ceremonial exchange or dress. As stressed by Setchell (1924), in his *Ethnobotany of Samoa*, plant names were given to gods or vice versa and songs and legends have developed around them and the "heroes, families, or villages, etc. they represent." One particular Samoan text of the battle of trees and stones" enumerates between 70 and 80 tree names.

The importance of body ornamentation and perfumery is attested to by the considerable time and expense devoted by most societies (very extravagant expenditures in the case of more affluent

societies) to clothing, jewelry, perfumes, and other items of personal adornment. Pacific island societies, similarly, placed great importance on the importance of plant products for body ornamentation and perfumery, with 44% (62 of 140) of all coastal species being used in body ornamentation and 21 species used to scent coconut oil or for perfumery (Appendix II).

Many places, such a Hawaii or Tahiti, are commonly associated with flower leis or sweet smelling flowers, such as the tiare Tahiti. The salusalu, kahoa and sisi, ula, and te bau, the Fijian, Tongan, Samoan, and Kiribati equivalents of the Hawaiian lei, are all of great social, ceremonial, magical or spiritual importance, with other Pacific societies having equivalent terms for such body ornamentation. Powell (1976), Bonnemaison (1985), Neal (1965) and McDonald (1978) all stress the ceremonial or magical importance of body ornamentation in Papua New Guinea, Vanuatu, Tuvalu and Hawaii, with Koch (1983) noting that ornaments used for special occasions in Tuvalu are now almost exclusively made of plants because "the longer-lasting ornaments succumbed to the puritanical zeal of the Samoan missionaries."

These few examples from the analysis of the utility of the plants of Pacific island coastal ecosystems shows the cultural sophistication and storehouse of empirical knowledge possessed by Pacific island societies in relation to their biodiversity inheritances. If analyses are performed for other ecosystems, both terrestrial and marine (Appendix I) and for all taxa, both wild and domesticated and plant and animal (Table 1), the "bio-utility" of the biodiversity to Pacific Island peoples becomes almost incomprehensible to the ordinary urban planner or scientist who has lost touch with the natural world and subsistence living systems. In short, the term "biodiversity" for people who depend on it and know it, particularly rural Pacific peoples with only limited opportunities for generation of cash incomes, takes on immense meaning. However, the economic, cultural and ecological value of biodiversity is rarely acknowledged in development plans, project documents, or aid proposals, despite the fact that the products and benefits provided by it (even in the case of coastal vegetation alone) would be extremely expensive or impossible to replace with imported substitutes.

7 THE NEED AND POTENTIAL FOR COMMUNITY-BASED BIODIVERSITY CONSERVATION (CBBC) STRATEGIES

Centuries of exploitation and, more recently, urban-industrial development have led to endangerment and extinction of the Pacific biodiversity inheritance throughout the Pacific. Forests, both primary and secondary, continue to be transformed into degraded savannas and fern-grasslands, mangroves and lagoons into housing and industrial estates, airports and other lifeless landscapes; polycultural traditional gardens into monocultural plantations; mineral deposits and their associated biota totally destroyed; and villages and urban areas divested of their remaining plants and animals to make way for industrial, commercial, and residential areas. Although some countries and territories have conservation legislation and systems of conservation areas, forest and marine products continue to be shipped off for a fraction of the world market price to Hawaii, Japan, South Korea and Australia. The trends of biodiversity endangerment and extinction are the same from the high continental islands of Melanesia to the smallest atoll islets of Polynesia and Micronesia

(Thaman and Clarke 1987).

Deforestation in the Pacific is proceeding at a frightening rate and has undoubtedly been the main cause of the extensive anthropogenic grasslands of highland New Guinea, the xerophytic niaouli (Melaleuca leucadendron) savanna lands of New Caledonia, the highly degraded "sunburnt lands", or talasiga, found throughout Fiji, and the rapidly expanding saafa (Panicum maximum) grasslands of Tongatapu in Tonga. Deforestation has led to severe erosion in Wallis and Futuna, the Cook Islands, French Polynesia and Hawaii where most of the indigenous forest has been removed, leaving degraded fernlands and grasslands no longer suitable for agriculture (Kirch 1982:4). Flenley and King (1984) go as far as to suggest that deforestation was responsible for the collapse of the pre-European megalithic culture on Easter Island.

In perhaps the most extreme case, by the turn of the century, the entire indigenous forest and most of the coastal strand forest of the 24 km^2 island of Nauru will have been transformed into a virtually unusable moonscape by open-cast phosphate mining and associated urbanisation (Manner et al. 1984).

The same holds true for marine resources. Sea turtles, whales, sharks, giant clams and black coral are endangered or extinct in some areas of the Pacific because of overexploitation (Lewis *et al*. 1988).

An issue of particular concern, in terms the endangerment of "human biodiversity" (Pacific peoples), is the shift from the state referred to by (Fisk 1972) as "subsistence affluence", where food supplies were diverse and abundant, and people, even in the Papua New Guinea highlands and on the smallest atolls, were reportedly well-nourished, to a situation where Pacific peoples, especially in urban areas, now have some of the highest or most rapidly increasing rates of malnutrition (e.g. infant malnutrition, anaemia, obesity, etc.) and nutrition-related metabolic and degenerative diseases (e.g., cardiovascular disease, hypertension, diabetes, gout, cancer and dental disease) in the world. This alarming development seems to be related for the most part to a dietary shift, primarily in urban areas, from fresh traditional plant and animal foodstuffs and breastfeeding to nutritionally-inferior, highly-processed imported foods, such as breastmilk substitutes, white rice and flour, sugar, alcohol and tinned foods (Coyne 1984; Thaman 1982, 1984, 1988). This nutrition and health crisis is clearly related to the declining diversity and consumption of both wild and domesticated foodstuffs from our wildlands and our marine and agricultural ecosystems, i.e., a loss of nutritional biodiversity.

Associated with all of these aspects of biodiversity erosion, and with modern institutionalised education and development planning, has been a loss of traditional biological knowledge and an appreciation of the subsistence and developmental importance of biodiversity.

As stressed above, the loss or impoverishment of biodiversity and the loss of ethnobiological knowledge represents an ecological, cultural and economic disaster which will lock Pacific societies more tightly into the vicious circle of economic and cultural dependency. There is, thus, a critical need for biodiversity conservation and education before it is too late.

A positive sign, and a recognition of the need for biodiversity conservation regionally, is the recent approval of The South Pacific Biodiversity Conservation Programme (SPBCP), a US$10.5 million programme designed to promote biodiversity conservation in the Pacific Islands. The SPBCP will focus on the promotion of biodiversity conservation and sustainable development through the establishment of a number of Conservation Area Projects (CAPs) in the SPREP member countries. Particular emphasis will be placed on the establishment of Conservation Areas (CAs) at the community or landowner level. In the establishment of CAs emphasis will be placed on achieving a balance between the management and utilisation of CAs and their biological resources to provide for both the cash and subsistence needs of resident communities, while at the same time maximising the conservation of biodiversity, particularly plant and animal species which are rare, endangered or of major economic, cultural and ecological importance. Where biodiversity conservation could result in landowners foregoing opportunities for economic development, alternative economic activities may be facilitated. Other members of the international AID and development community, such as UNDP, the Asian Development Bank, ESCAP, the World Bank, USAID, the Australian International Development Assistance Bureau (AIDAB) and NGOs, such as Greenpeace, the World Wildlife Fund (WWF), The Nature Conservancy (TNC), the Foundation for the Peoples of the South Pacific (FSP) and the USP-based South Pacific Action Committee for Human Ecology and the Environment (SPACHEE), to mention only a few, are also getting on the "biodiversity bandwagon".

Unfortunately, most agencies, except for some NGOs, but including SPREP, have focussed their efforts on expensive conservation area (CA) projects instead of on the systematic nationwide promotion of biodiversity conservation at the community level. Most of the money earmarked for biodiversity conservation is spent on administration and on the salaries, travel, per diem and consultancy fees of grossly overpaid and overpriced staff and consultants (usually from "privatised" overseas consultancy firms which tap into tied aid funds), and NOT on community-based self-help programmes and environmental education that could empower people at the community level to conserve biodiversity.

As stressed in the introduction, it is argued that, in terms of cost- and biodiversity-conservation effectiveness (measured in terms of the number of endangered and ecologically AND culturally important ecosystems and taxa that are protected or increase in numbers), the major effort should be placed on conservation of biodiversity at the local community or landowner level, through the implementation of multi-ecosystem "community-based biodiversity conservation" (CBBC). In other words, local communities and landowners (including reef, lagoon and ocean owners) must be given the tools and incentives to protect all important ecosystems and plants and animals so that they will be available for use by future generations of landowners. This is not to suggest that national initiatives for the establishment of conservation areas is not also a priority.

For such broad-based community or national biodiversity conservation programmmes to be successful, a major component, in terms of both funding and personnel, must be devoted to formal and non-formal public education to create (recreate?) awareness of the importance of biodiversity and biodiversity conservation to sustainable development.

8 RECOMMENDATIONS

To promote multi-ecosystem "community-based biodiversity conservation" (CBBC), individuals, local bodies, governments and non-governmental, international organisations and academic institutions must resolve themselves to creating an environment which will foster the protection and enhancement of important ecosystems and biodiversity at the community level. Extensive, primarily self-help programmes must be mounted to encourage biodiversity preservation, not only in rural areas and wildlands, but also in and around towns and cities. Although there are countless recommendations that could be made with respect to the systematic promotion of multi-ecosystem "community-based biodiversity conservation" (CBBC) in the Pacific islands systems, the following are some general recommendations that could serve as an initial blueprint for a maximisation of biodiversity preservation:

1. That multimedia programs be developed, in the vernacular, to stress the nature and long term economic, social, and ecologial importance of existing biodiversity and the problems associated the loss of biodiversity.

2. That units be written for use in school science or social science/geography curricula, at appropriate levels, on the nature and importance of biodiversity to Pacific societies (such units should be examinable and include field activities for both rural and urban areas).

3. That intersectoral working groups or committees be established in all countries to compile and published lists (with both vernacular and Latin names) of the biological diversity in representative ecosystems at the community and national levels.

4. That in-depth research be funded and conducted to study important ecosystems, their component plants and animals, cultural ecology, husbandry, and their economic, particulary their subsistence economic, importance (i.e., their ethnobiology), in the context of national and community development.

5. That all landholders/owners be encouraged to preserve and manage representative areas of all productive ecosystems listed in the Appendix as ecologically-important and culturally-utilitarian components of their land and marine use and tenure systems.

6. That national park and conservation area development include the promotion and establishment of village-level or landowner reserves or micro-parks in an effort to spread the benefits of park and biodiversity conservation initiatives (Thaman 1985).

7. That the nutritional and economic importance of wild terrestrial and marine foods and traditional local food crops be widely stressed, and included as a capital item, in development plans and be made a component of environmental impact assessment procedures.

8. That important wild or cultivated medicinal plants, perfume and ornamental plants and other culturally important plants and animals be identified and consciously protected or planted in *in situ* and *ex situ* programmes .

9. That the magico-religious, spiritual and cultural importance of biological resources (e.g., totemic species) and peoples' traditional connections with the land and ocean be popularised in an attempt to get local communities to protect representative species and ecosystems.

10. That, where possible, the protection or enhancement of useful plants, animals and components of terrestrial and marine ecosystems be required or encouraged in all agricultural, forestry, fisheries, livestock, tourism, and urban-industrial development projects.

11. That deliberate planting, transplanting, translocation or protection of endangered indigenous plant and animals species from endangered ecosystems to other appropriate areas or islands (i.e., *ex situ* programmes) be actively encouraged, with appropriate quarantine procedures.

12. That severe pruning, pollarding, and coppicing be encouraged as an alternative to complete plant removal, when clearing new garden areas for both commercial and subsistence crops or livestock production.

13. That national and regional legislation be passed and enforced that ensures that local communities/practioners receive appropriate monetary benefits from their "intellectual property rights" (IPR) related to the use or exploitation of both their biodiversity resources and their tradtional knowledge by scientist, private companies and other agencies involved in biodiversity research, bioprospecting and other activities which depend on the biodiversity heritages of Pacific peoples.

There are obviously other means of promoting multi-ecosystem "community-based biodiversity conservation" (CBBC) by individuals, communities, local bodies, governments and non-governmental and international organisations. The main point that must be continually stressed, however, is that the main objective of biodiversity conservation in the Pacific Islands should probably be to benefit local communities, rather than to preserve endemic plants and animals for science or in the hope of finding a cure for AIDS in our forests or lagoons. It must be stressed over and over again that biodiversity will probably remain the basis for cultural, economic and ecological survival for most Pacific Island communities and nations. Although there are undoubtedly new technologies and some new plant and animal species that could enhance cash incomes and the quality of life in all areas of the Pacific, the basis for survival will remain the wild and domesticated plants and animals that have served Pacific societies for millennia.

REFERENCES

Baines, G.B.K. 1979. Mangroves for national development. A report on the mangrove resources of Fiji. (Unpublished manuscript).

Bonnemaison, J. 1985. The tree and the canoe: Roots and mobility in Vanuatu societies. In *Mobility and identity in the Pacific*, ed. M. Chapman. Special issue of *Pacific Viewpoint 26(1):30-62.*

Coyne, T.(Badcock, J. and Taylor, R., eds.). 1984. *The Effect of Urbanisation and Western Diet on the Health of Pacific Island Populations*. Technical Paper No.186. South Pacific Commission, Noumea. 1984.

Dahl, A.L. 1980. *Regional Ecosystems Survey of the South Pacific Area*. Technical Paper No. 179. South Pacific Commission, Noumea.

Fisk, E.K. 1972. Motivation and modernization. *Pacific Perspective* 1(1):21-23.

Flenley, J.R. and King, S.M. 1984. Late Quaternary pollen records from Easter Island. *Nature* 307:47-50.

Kirch, P.V. 1982. Ecology and adaptation of Polynesian agricultural systems. *Archaeology in Oceania* 17(1):1-6.

Khoo, K.M. 1976. Optimal utilisation and management of fisheries resources. In *Proc. of a seminar on the development of the fisheries sector in Malaysia. Jour. of the Malaysian Economics Association* 13:40-50.

Koch, G. (G. Slatter, translator). 1983. *The material culture of Tuvalu*. Suva: Institute of Pacific Studies, University of the South Pacific (originally published in German in 1961 by Museum fur Volkerkunde, Berlin).

Lal, P.N., Swamy, A. and Singh, P. 1983. Mangroves and secondary productivity: Fishes associated with mangroves in Wairiki Creek, Fiji. In *Proceedings of an interdependent workshop, 24 February 1983, Suva, Fiji*, P.N. Lal, ed. Technical report 5. Suva: Fisheries Division, Ministry of Agriculture and Fisheries.

Lewis, A.D., Adams, T.J.H. and Ledua, E. 1988. Fiji's giant clam stocks -- A review of their distribution, abundance, exploitation and management. In Copland, J.W. and Lucas, J.S. (eds.), *Giant clams in Asia and the Pacific*. Australian Centre for International Agricultural Research, Canberra. Pp. 66-72.

McDonald, M.A. 1978. *Ka lei: The leis of Hawaii*. Honolulu: Topgallant Publishing.

Manner, H.I., Thaman, R.R., and Hassall, D.H. 1984. Phosphate-mining induced vegetation changes on Nauru Island. *Ecology* 65(5):1454-1465.

Neal M.C. 1965. *In gardens of Hawaii*. Bernice P. Bishop Museum special publication 50. Honolulu: Bishop Museum Press.

Perry, L.M. and Metzger, J. 1980. *Medicinal plants of East and Southeast Asia: Attributed properties and uses*. Cambridge: The M.I.T. Press.

Powell, J.M. 1976. Ethnobotany. In *New Guinea vegetation*, ed. K.Paijmans, pp 106-183. Amsterdam: Elsevier Scientific Publishing Co.

Setchell, W.A. 1924. *American Samoa: Part I Vegetation of Tutuila Island, Part II. Ethnobotany of the Samoans, Part III. Vegetation of Rose* Atoll. Vol. XX (inclusive). Washington D.C.: Department of Marine Biology, Carnegie Institution of Washington.

Stoddart, D.R. 1992. Biogeography of the tropical Pacific. *Pacific Science* 46(2):276-293.

Thaman, R.R. 1982. Deterioration of traditional food systems, increasing malnutrition and food dependency in the Pacific islands. *Jour. of Food and Nutrition* 39(3):109-121.

___. 1984. Food for Urbanizing Polynesian Peoples. *Proceedings of the Nutrition Society of New Zealand* 1983 8:26-37.

___. 1985. Microparks in the Pacific Islands: The Relevance of Traditional and Modern Small-Scale Conservation Areas in the Context of Nature Conservation in the Pacific Islands. In *Report of the Third South Pacific National Parks and Reserves Conference, (Apia, Western Samoa) Vol.II: Collected Papers*. P.E.J. Thomas, ed.) South Pacific Regional Environmental Programme (SPREP), South Pacific Commission, Noumea. Pp. 215-236.

___. 1988. Health and Nutrition in the Pacific Islands: Development or Underdevelopment. *Geojournal* 16(2):211-227.

___. 1992. Batiri kei Baravi: The ethnobotany of Pacific Island coastal plants. *Atoll Research Bulletin* No. 361:1-62.

Thaman, R.R. and Clarke, W.C. 1987. Pacific Island Agrosilviculture: Systems for Cultural and Ecological Stability. *Canopy International* 13(1):6-7; 13(2):8-10; 13(1):8-9 (three-part series).

Watling, D. 1985. *A Mangrove management plan for Fiji. Phase 1. Zonation requirements and a plan for the mangroves of the Ba, Labasa and Rewa Deltas*. Suva: Government Printer.

Appendix I. Major inland, aquatic and coastal terrestrial and marine ecosystems which: 1) constitute the major resource-use zones for most Pacific Island communities; and, 2) could serve as the focus for multi-ecosystem "community-based biodiversity conservation (CBBC) development in the Pacific Islands.

Ecosystem Type	Description
1 **TERRESTRIAL/FRESHWATER ECOSYSTEMS**	
1.1 Inland Native Forest	Primary or relatively undisturbed indigenous lowland, slope or montane forest, including tropical rainforests and seasonal forests; found on most of the larger islands of Melanesia and on some of the larger, or isolated and uninhabited islands of Polynesia and Micronesia
1.2 Mature Fallow Forest	Old-age fallow forest, with a significant component of exotics, often deliberately planted useful trees, and including stands of bamboo and village tree groves; common in Melanesia, large-island Polynesia and Micronesia, and occasionally present on some smaller islands.
1.3 Grassland/Woodland	Anthropogenic and natural grasslands, meadows, savanna lands and woodlands where grass or sedge cover is a dominant or co-dominant component of the vegetation, and where exotic species are often dominant (not including fenced or improved pasture); found in lowland and upland areas of the larger islands throughout the Pacific.
1.4 Scrubland	Natural or disturbed areas, where long term disturbance, such as burning or grazing or the poverty of the environment precludes the establishment of significant tree cover, and where a significant component of the plants consist scrub ferns or exotic, often weedy species; found throughout the Pacific in both rural and urban areas.
1.5 Shifting Agricultural Land	Active agricultural areas characterised by extensive and intensive shifting agriculture with alternating cropping periods and variable fallow periods and a resultant mosaic of a wide range of root crops and other short-term ground crops and long-term tree crops and perennials interspersed with areas forest

	fallow, bush fallow or grassland fallow; common on high islands and large limestone islands throughout the Pacific and characterised by both subsistence and mixed subsistence-commercial cropping systems.
1.6 Permanent/Semi-permanent Agricultural Land	Active agricultural areas characterised by intensive, almost permanent cropping, often with scattered trees but little fallow; found throughout the Pacific in the forms of irrigated, mounded or excavated taro or sweet potato cultivation, rice cultivation or cash-cropping of short-term cash crops such as vegetable, ginger or tobacco, often on alluvial soils or in areas of high population density, such as urban or peri-urban areas.
1.7 Plantations	Active agricultural areas dominated by monocultural plantings of perennial tree crops or other long-term commercial crops, such as coconut palms, coffee, tea, cocoa, bananas or sugarcane, often with scattered trees or living fencing, or undergrazed by livestock; found in all areas of the Pacific.
1.8 Pasture	Areas developed for grazing, including improved and unimproved grasslands and scrubland, often fenced and usually dominated by exotic species; found on most larger islands and some smaller islands, but uncommon or absent on most atolls.
1.9 Houseyard/Urban Gardens	Horticultural (the focus being on the plant rather than the crop) gardens characterised by permanent mixed-cropping of short-term ground crops and trees, shrubs and other perennials around dwellings or workplaces, but also including botanical gardens, parks, lawns, hedges and living fencing and roadside plantings; found in urban and rural areas throughout the Pacific.
1.10 Ruderal Sites	Roadsides, waste places and other disturbed sites usually dominated by exotic weedy species; ubiquitous throughout the Pacific, although less common in very isolated rural areas where there is little transportation or urban/built development.
1.11 Wetlands	Poorly-drained freshwater and brackish water swamps, bogs and marshland vegetation associations;

	present throughout the Pacific.
1.12 Rivers/Lakes	Freshwater bodies including rivers, lakes and ponds, and riparian vegetation bordering rivers and lakes or river floodplains; found on high islands throughout the Pacific, but absent on most raised limestone islands and atolls where there is no surface water.
1.13 Fishponds/Aquaculture	Freshwater aquacultural developments, such as fishponds; found in some countries of the region.
1.14 Mangrove Forest	Trees and shrubs occurring in coastal, lagoonal and estuarine tidal areas; found naturally throughout Melanesia, Western Polynesia and Micronesia, and as introduced communities in Eastern Polynesia.
1.15 Coastal Strand Vegetation	Vegetation occurring along sandy or rocky coastal areas or small islets a few metres above sea level and under the influence of salt spray and storm surge; found throughout the Pacific and characterised by ubiquitous salt-tolerant pan-Pacific or pan-tropical plants.
1.16 Beaches and Dunes	Shorelines with unstable sand or rubble deposits; found throughout the Pacific, sometimes consisting of geologically and climatically ancient, sparsely vegetated dune deposits.
1.17 Bare Rock	Unvegetated or sparsely vegetated areas dominated by bare rock, including cliff faces, beach rock, exposed limestone, recent volcanic deposits; found throughout the high-island Pacific and on raised limestone islands and atolls.
1.18 Built/Urban	Non-vegetated structures and developments including buildings, transportation networks, etc.; found throughout inhabited islands.

2 **MARINE ECOSYSTEMS**

2.1 Estuaries	The lower, usually tidal sections of rivers where freshwater mixes with seawater; found on larger, more geologically-ancient islands with large rivers.

2.2 Intertidal Zone	Areas of old fringing reef or tidal flats that are above sea level during low tide, but submerged at high tide; found on most islands, except some raised limestone islands or reef islets with no fringing reef or submerged coastal plains.
2.3 Lagoons	Bodies of saltwater or brackish water more or less separated from the open sea by reefs, islets or other barriers; found associated with most islands, except some raised limestone islands or reef islets with no lagoons or barrier reefs.
2.4 Fishponds/Maricultural Areas	Artificially constructed fishponds or other developments for the purpose of fishfarming or mariculture; found in coastal or lagoonal areas in many countries, sometimes of pre-European-contact origin.
Coral Reefs	Reefs including purely coral reefs, algal reefs, barrier reefs, fringing reefs and lagoon or patch reefs; found throughout the Pacific.
Island Shelf/Reef Platform	Areas between depths of 50 and 200 m adjacent to islands or in the forms of banks, gradual slopes, pinnacles or seamounts; found off most island groups, although less extensive off most atolls and smaller islands.
Open Ocean	Ocean areas deeper than 200 m; found within EEZs throughout the Pacific

Appendix II. Frequency of the usage for specified purposes of 140 Pacific island coastal plant species.

Purpose/Use	Ferns x/10	Herbs x/17	Grasses /Sedges x/11	Vines/ Lianas x/14	Shrubs x/26	Trees x/62	Total x/140
Medicinal/Health	6	15	7	11	23	51	113
General Construction	-	-	-	-	6	54	60
Body Ornamentation	6	8	3	7	12	26	62
Firewood/Fuel	-	-	-	-	8	43	51
Ceremony/Ritual	3	4	-	5	6	23	41
Cultivated/Ornamental	4	3	-	2	10	20	39
Tools/Toolmaking	-	-	-	-	4	33	37
Emergency/Famine Foods	4	5	2	2	4	18	35
Boat/Canoe Building	-	-	1	-	3	30	34
Dyes/Pigments	-	-	-	2	4	24	30
Magic/Sorcery	1	6	1	1	6	14	29
Fishing Equipment	-	1	2	-	8	17	28
Cordage/Fibre	2	2	2	6	3	10	25
Games/Toys	-	-	1	4	4	16	25
Supplementary Foods	2	2	-	2	3	14	23
Scenting Oil/Perfumery	1	1	1	1	6	11	21
Fertiliser/Mulching	1	2	2	1	4	11	21
Weapons/Traps	-	-	-	-	6	14	20
Woodcarving	-	-	-	-	1	18	19
Food Parcelisation	3	1	-	3	1	11	19
Animal Feed	1	4	-	3	2	9	19
Legends/Mythology	-	-	-	-	3	15	18
Handicrafts	1	1	3	2	1	9	17
Clothing	-	1	3	-	1	9	14
Musical Instruments	-	-	-	-	1	13	14
Cooking Equipment	-	-	-	-	1	12	13
Fish Poisons	-	-	-	3	4	4	11
Export/Local Sale	-	1	-	-	2	8	11
Adhesive/Caulking	-	1	-	1	-	9	11
Fire by Friction	-	-	-	-	1	8	9
Soap/Shampoo	-	1	-	3	3	2	9
Containers	-	-	-	-	1	7	8
Repellents/Fumigants	-	-	-	-	2	6	8

Wild Animal Foods	-	-	-	-	3	5	8
Tannin/Preservatives	-	-	-	-	1	6	7
Antitoxins	-	1	-	1	1	4	7
Living Fences/Hedges	-	1	-	-	1	5	7
Staple Foods	-	1	-	-	-	5	6
Drinks/Beverage	-	1	-	2	1	1	5
Strainers/Filters	-	-	2	-	-	3	5
Toilet Paper	-	-	-	-	1	4	5
Land Reclamation	-	-	-	-	-	5	5
Calendars/Clocks	-	-	-	-	-	5	5
Contraceptives/ Abortifacients	-	-	-	-	3	2	5
Thatching/Roofing	-	-	-	-	1	3	4
Illumination	-	-	-	-	-	4	4
Combs	-	-	-	-	-	4	4
Animal Cages/Roosts	-	-	-	-	-	4	4
Oils/Lubricants	-	-	-	-	-	3	3
Brushes	-	-	-	-	-	3	3
Fans	-	-	-	-	-	3	3
Corks	-	-	-	-	-	3	3
Fishing bait	-	-	-	-	-	3	3
Other Uses*	-	-	2	-	5	27	34
TOTAL	35	63	32	62	161	671	1024
NO USES	-	1	1	-	-	-	2

* Other uses include stimulants/teas, flavouring/spices, ear cleaners, splints, aphrodisiacs, hair remover, masticants/chewing gum, abrasives, tooth brushes, cigarette wrappers, coconut climbing bandages or harnesses, measuring tapes, fireworks, windbreaks, sand screens, ladders, walking sticks, tethering posts, punishment/torture, communication/language, and computation or counting.

Appendix III. Coastal plant species of particular cultural utility based on an analysis of the uses of 140 widespread coastal littoral and mangrove species (Note: not including a wide range of ecological functions or uses).

Latin Name	Uses
Cocos nucifera	125
Hibiscus tiliaceus	57
Pandanus tectorius	53
Calophyllum inophyllum	43
Cordia subcordata	40
Guettarda speciosa	36
Scaevola sericea	32
Pemphis acidula	30
Thespesia populnea	26
Rhizophora spp.	25
Tournefortia argentea	23
Casuarina equisetifolia	22
Premna serratifolia	22
Morinda citrifolia	22
Pipturus argenteus	21
Terminalia catappa	21
Ficus tinctoria	21
Ficus prolixa	20
Erythrina variegata	19
Inocarpus fagifer	18
Hernandia senora	18
Lumnitzera littorea	17
Pisonia grandis	17
Bruguiera gymnorhiza	16
Nipa fruticans	14
Barringtonia asiatica	14
Mammea odorata	14
Intsia bijuga	13
Cycas circinalis	13
Gardenia taitensis	12
Sida fallax	11
Triumfetta procumbens	11
Vitex spp.	11
Dodonea viscosa	11
Santalum spp.	10
Mammea odorata	10
Entada phasioloides	10

Cerbera manghas	10
Clerodendrum inerme	10
Cassytha filiformis	10
Tacca leontopetaloides	9
Crinum asiaticum	9
Ficus obliqua	8
Polypodium scolopendria	8
Neisosperma oppositifolia	8
Metroxylon spp.	7
Ipomoea pes-caprae	7