Conservation in the South Pacific Island Region

prepared for
IUCN

by

Raymond F. Dasmann

Professor, Environmental Studies, University
of California, Santa Cruz, California.
Consultant to IUCN for South Pacific Region

1979

With financial assistance from
the
United Nations Environment Programme

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

Survey of South Pacific Island Region National Parks And Equivalent Reserves

1. Introduction

The South Pacific region extends from Palau and Papua New Guinea eastward to the Pitcairn Islands. It occupies a large part of the planet's surface and encompasses more than 100 degrees of longitude and 50 degrees of latitude north and south of the eqator. It represents an extensive biogeographic realm, the Oceanian Realm of Udvardy (1975), which extends nearly 14,000 kilometers from east to west. Within this area the sea predominates, and dry land is confined to thousands of islands, mostly small in size and often widely separated from each other.

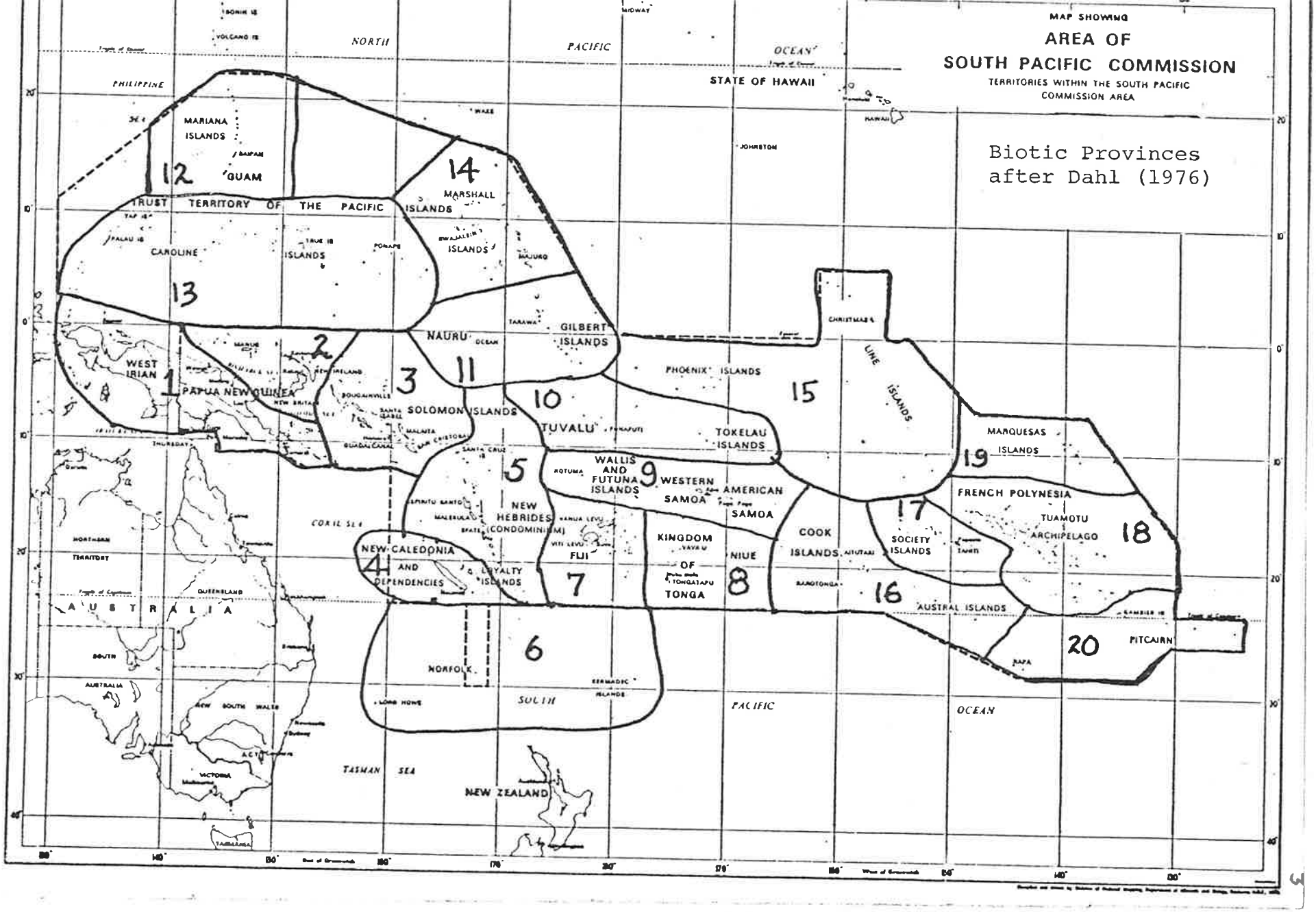
The terrestrial animal life of this region is principally related to that of the Indomalayan Realm, but includes species derived from the Australian realm, to which Papua New Guinea belongs, and has some species of apparent Neotropical origin (Udvardy, 1975). However, the isolation of the island groups has lead to separate evolutionary pathways on many islands and unique endemic biotas. This warrants the separation of the terrestrial plant and animal life into 7 separate biogeographic provinces, as defined by Udvardy, or into 20 separate biotic provinces, defined by Dahl (1976) (Table 1). The marine biota is also remarkably diverse, but more uniform throughout the area (Ray, 1975). There is, however, a decline in diversity from Palau and Papua New Guinea eastward and presumably corresponding differences in ecosystems structure from west to east. This has led Dahl to include both terrestrial and marine biotas within his 20 provinces (Figure 1).

The biotic diversity of the area is in fact greater than the number of biotic provinces would indicate, since each larger island is itself a center of endemism, supporting a different flora and fauna from its neighbors. This results in a degree of complexity not common on continents, and one which constitutes a challenge to conservation. Since the peoples of the Pacific each occupy a biologically unique area they have responsibilities for conservation which exceed those of most people. Yet they must seek a livelihood and achieve higher levels of economic well-being in part through utilization of these unique forms of animal or plant life. They cannot be expected to bear this responsibility on their own, since most islands lack the economic resources to do so. Conservation in the South Pacific is necessarily a concern to all to whom the future of life on earth is important.

TABLE 1

BIOTIC PROVINCES OF THE SOUTH PACIFIC BASED ON DAHL (1976)

1. New Guinea
2. Bismarc Archipelago
3. Solomon Islands
4. New Caledonia - Loyalty Islands
5. New Hebrides - Santa Cruz Islands
6. Norfolk, Lord Howe, Kermadec Islands
7. Fiji
8. Tonga - Niue
9. Samoa - Wallis and Futuna
10. Tuvalu - Tokelau
11. Kiribati
12. Marinana Islands
13. Caroline Islands
14. Marshall Islands
15. Phoenix - Line - Northern Cook Islands
16. Cook - Austral Islands
17. Society Islands
18. Tuamotu Archipelago
19. Marquesas Islands
20. Pitcairn-Gambier-Rapa Islands


MAP SHOWING
AREA OF
SOUTH PACIFIC COMMISSION
TERRITORIES WITHIN THE SOUTH PACIFIC COMMISSION AREA
Biotic Provinces after Dahl (1976)
NORTH PACIFIC OCEAN
STATE OF HAWAII
PHILIPPINE
MARIANA ISLANDS
GUAM
TRUST TERRITORY OF THE PACIFIC ISLANDS
CAROLINE ISLANDS
MARSHALL ISLANDS
NAURU
GILBERT ISLANDS
WEST IRIAN
PAPUA NEW GUINEA
SOLOMON ISLANDS
TUVALU
PHOENIX ISLANDS
LINE ISLANDS
TOKELAU ISLANDS
MARQUESAS ISLANDS
WALLIS AND FUTUNA ISLANDS
WESTERN SAMOA
AMERICAN SAMOA
FRENCH POLYNESIA
TUAMOTU ARCHIPELAGO
SOCIETY ISLANDS
NEW HEBRIDES (CONDOMINIUM)
FIJI
KINGDOM OF TONGA
NIUE
COOK ISLANDS
AUSTRAL ISLANDS
PITCAIRN
NEW CALEDONIA AND DEPENDENCIES
LOYALTY ISLANDS
NORFOLK
CORAL SEA
TASMAN SEA
SOUTH PACIFIC OCEAN
AUSTRALIA
NEW ZEALAND
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Thus far the impact of exploitation and development, carried forth primarily for the benefit of the industrialized world, has been destructive to the plants and animals indigenous to the South Pacific as well as to the peoples and cultures of the region. Many forms of life have become extinct, and a greater number are seriously endangered. Economic development will no doubt continue, but it must be done in ways that do not endanger the long-term survival of life in the South Pacific.

It is seldom possible to achieve conservation of biotic diversity on a species by species basis. Although this may seem practical for some of the larger, or better-known species, it cannot succeed when applied to those thousands of species which are inconspicuous, little known, or still to be described in scientific language. It may be useful to high-light the need to conserve a particular species - a whale for example, or a bird-of-paradise - in order to attract public attention, but the conservation effort must take into account the total environment on which the species depends, with all of its inter-relationships, human and non-human. If the particular environment on which a species depends can be recognized and protected, all of the species inhabiting that environment will be benefitted. Of particular importance are those areas, designated as critical habitats, which serve to support large numbers of individuals or species during periods of their lives when they are most vulnerable. Examples are coral reefs, mangrove forests, sea-grass beds, or sea-bird rookeries. Identification and protection of such critical habitats can be a key to successful conservation.

Dahl (1976) has listed approximately 70 "biomes" in the South Pacific (Table 2). These are, in fact, either plant communities defined by their structure, for example, tropical rainforests; habitat types defined geomorphologically, for example, rocky coasts; or critical habitats, such as sea-bird rookeries. Effectively his list provides a guide to the physical and biological habitats which must be given attention if the diversity of life in the South Pacific is to be maintained. Some of these habitats, for example atoll and beach forests, are found in nearly all biotic provinces. Others, such as bogs or reed swamps are confined to a few. Some, such as lowland rain forests, are subject to endangerment from logging or land-clearing. Others, such as sea mounts, are not yet seriously threatened. Much remains to be discovered before a complete list can be presented. All are important for conservation.

The conservation of biotic diversity in the South Pacific is ultimately the responsibility of the people of the South Pacific. It is they who will decide whether a particular species or community survives or becomes extinct. It is they who will benefit if conservation is successful, or endanger their own survival if it fails. Yet is is also an international concern to which all nations who can afford to do so should give support.

The area discussed in this paper is that included in Dahl's list of biotic provinces. It excludes Australia, New Zealand and the islands near their shores. It is offered as a contribution to the South Pacific Regional Environment Programme which is being carried forward through the South Pacific Commission and the South Pacific Bureau for Economic Cooperation, with support from the United Nations Environment Programme.

TABLE 2

PRINCIPAL HABITAT TYPES OF SOUTH PACIFIC ISLANDS

1 Lowland rain forest
2. Montane rain forest
3. Bamboo forest
4. Cloud forest
5. Riverine forest
6. Swamp forest
7. Seasonal forest
8. Semi-deciduous forest
9. Subtropical rain forest
10. Mangrove forest
11. Beach strand forest
12. Woodland
13. Scrub
14. Serpentine vegetation
15. Dwarf-shrub heath
16. Bog
17. Woodland savanna
18. Tree savanna
19. Shrub savanna
20. Grassland
21 Flood savanna
22. Fresh water march
23. Salt marsh
24. Rock Desert
25 Sand desert
26. Floating meadow
27. Reed swamp
28. Submerged aquatics
29. Floating aquatics
30. Permanent lakes/ponds
31. Intermittent lakes/ponds
32. Brackish lakes/ponds
33. Impoundments
34. Mountain stream
35. Lowland stream
36. Sea bird rookeries
37. Sea turtle nesting sites
38. Caves
39. Marine algae beds
40. Sea grass beds
41. Coral reefs
42. Algal reefs
43. Rocky shores
44. Beach
45. Lagoon
46. Estuary
47. Marine lake
48. Marine cave
49. Dredged soil bank
50. Artificial reef
51. Maricultural area
52. Offshore terrace
53. Offshore slope
54. Continental shelf
55. Submarine canyon
56. Continental slope
57. Abyssal plain
58. Submarine trench
59. Submarine ridge
60. Sea mount

Based on Dahl (1976) with some simplification and name changes.

TABLE 3

AREA AND HUMAN POPULATION OF SOUTH PACIFIC

	Area, sq. k.	Population (1975-76)	Density Per sq. k.
Papua New Guinea	463,476	2,687,000	6
Solomon Islands	28,530	196,825	7
New Caledonia	19,103	134,000	7
Fiji	18,200	575,000	32
New Hebrides (Vanuatu)	11,800	96,500	8
French Polynesia	4,022	140,000	35
Western Samoa	2,934	152,000	51
Trust Territory of Pacific	1,879	119,000	59
Tonga	750	97,000	130
Kiribati (Gilbert Islands)	684	54,500	80
Niue	259	3,834	11
Cook Islands	233	18,112	80
American Samoa	197	30,000	150
Tuvalu (Ellice Islands)	26	7,500	300
Nauru	21	7,200	340

2. Background

The South Pacific has been of interest to the outside scientific community at least since the voyages of Captain James Cook in the 18th century. This interest was heightened by the scientific studies of Charles Darwin and Alfred Wallace during the middle decades of the 19th century. Long before that, however, the animal and plant life of the region was of interest to the people who lived there. The species were observed, and their habits and characteristics noted by those who had a more direct concern with this knowledge, since their lives and those of other species which occupied their islands were closely interwoven. The Pacific people arrived on islands which had long before been colonized by other species. Like all invaders, their initial impact was likely to be destructive to other forms of life. In New Zealand, for example, the original human colonizers were responsible for exterminating the moas, the giant, flightless birds which had originated on those islands. Elsewhere the influence of fire, and domestic animals, along with agricultural practices can be expected to have affected the original species balances. Over time, however, the peoples of the Pacific were forced to adapt their ways of living to the ecological realities of their islands. They had no overseas supply base to support them if their agriculture failed or if they exterminated species on which their survival depended. A traditional conservation-oriented way of life developed, through which people could survive and thrive without destroying the environment on which their survival was based.

Under the impact of later invasions from Europe and Asia, and through the influence of foreign science and technology much of the traditional knowledge was lost, or set aside and forgotten because it was thought to be of lesser value. Much of it, however, has been carried forward by those who continue to practise traditional ways. This knowledge, relating to how a particular kind of plant or animal can be helpful or harmful to the survival and well-being of human beings, may be more useful today than a knowledge of its evolutionary relationships or other features of scientific interest. A blending of scientific and traditional knowledge may be of greatest importance to the future of island life. Efforts to locate, describe and perpetuate traditional knowledge concerning plants and animals, along with traditional conservation-oriented practices, deserve widespread support.

In most Pacific countries land ownership is also based on tradition and custom. Most land on most islands belongs to kinship groups, who pass their rights to the land down from generation to generation. Alienation of land by sale or barter does not occur, except under unusual circumstances. This applies not only to the lands that are obviously inhabited, but also to areas that are wild and remote, including most uninhabited islands. Such an ownership pattern does not permit the establishment of parks or reserves in the usual manner of North America or Europe, where land ownership is transferred to the government by sale or exchange. Most nature reserves which now exist in the Pacific have been established on the relatively small areas of land which have been alienated in the past and are now in government or individual control.

The areas most in need of protection, however, are usually in customary ownership. The land ownership pattern could be considered an obstacle to conservation. It is also an opportunity and a challenge. It has been found in Papua New Guinea, for example that the extra effort to convince all of the customary owners of the importance of protecting an area or a species pays off in the long run. Conservation is taken more seriously when the traditional owners are prepared to enforce it than when it is a responsibility only of a few government employees.

The island groups of the South Pacific remain in a wide range of categories under international law. Less than a half century ago nearly all were colonies, protectorates, or territories associated with European or Asian powers. During the last decade, however, movement toward independence has been accelerating. By 1980, nine countries will have achieved independence - Tonga, Western Samoa, Fiji, Papua New Guinea, Nauru, Solomon Islands, Tuvalu, Vanuatu, and Kiribati. The Cook Islands and Niue are self-governing, and varying degrees of local autonomy are being achieved by those which remain under the stewardship of metropolitan countries. At the time of writing the status of the various Micronesian islands is still confused, but for the time being most remain under United States control.

It is possible to rate the various island groups in order of their importance for nature conservation, but only if the terms are carefully defined. If one considers the diversity of habitats and the numbers of endemic species which are supported, then eight countries can be considered of exceptional importance, ten of high interest, and the remaining six of moderate to low interest (table 4). However the need for conservation remains important even to those nations that have little diversity and few or no endemic species. Among the self-governing and independent countries most have some degree of protective legislation covering fauna and flora, or enabling the establishment of nature reserves. Among the islands administered by other countries most share in the protective legislation of their metropolitan stewards. There is a need, however, for a more unified approach to conservation, since most islands share common wildlife resources - migratory birds, fish, mammals, reptiles and invertebrates. Thus far only tentative steps have been taken toward a unified approach, such as the initialing, but without ratification as yet, of the South Pacific Convention for the conservation of Nature, and the establishment of a regional fisheries agency.

A number of international programmes are of particular interest to the South Pacific. The Convention for the Preservation of the World Cultural and Natural heritage is administered through Unesco. Provision is made through this convention for those nations with unique and outstanding natural and cultural features to enter these on the World Heritage List, or the List of the World Heritage in Danger. If accepted, assistance can be provided to enable the nations concerned to bring these sites up to international standards and to maintain them in accordance with the principles agreed upon by the signatory states.

TABLE 4

SUMMARY OF CONSERVATION INTEREST AND STATUS

Political status	Conservation interest	Nature reserves	Faunal protection
Independent			
Fiji	Exceptional	Yes	Yes
Kiribati	Moderate	Yes	Partial
Nauru	Low	No	None
Papua New Guinea	Exceptional	Yes	Yes
Solomon Islands	Exceptional	Yes	Yes
Tonga	High	Yes	Yes
Tuvalu	Low	No	None
Vanuatu (1980)	Exceptional	No	Partial
Western Samoa	Exceptional	Yes	Partial
Self-governing			
Cook Islands	High	No	Yes
Niue	Moderate	No	No
France			
Austral Islands	Low	No	Yes
Loyalty Islands	High	Yes	Yes
Marquesas Islands	High	Yes	Yes
New Caledonia	Exceptional	Yes	Yes
Society Islands	High	Yes	Yes
Tuamotu Islands	High	Yes	Yes
Wallis & Futuna	Moderate	No	Yes
United States			
American Samoa	High	Yes	Yes
Caroline Islands	Exceptional	Yes	Yes
Mariana Islands	Exceptional	Yes	Yes
Marshall Islands	High	Yes	Yes
Australia			
Norfolk Island	Moderate	No	Yes
Lord Howe Island	Moderate	No	Yes
New Zealand			
Kermadec Islands	Moderate	Yes	Yes
Tokelau Islands	Moderate	No	No
United Kingdom			
Pitcairn-Islands	Moderate	No	No

Unesco also, through the Man and the Biosphere Programme (MAB), makes provision for the establishment of biosphere reserves, areas set aside for their long-term scientific, ecological and educational values. These can include both natural and cultural areas, inhabited or uninhabited, and representing a wide variety of conditions, from untouched wild areas to those recovering from past degradation. Such reserves can be used equally for the protection of ways of life as for the protection of natural features and wild species. Their usefulness to the South Pacific may exceed that of conventional national parks or nature reserves. Unfortunately, most island states do not belong to Unesco, and it is difficult for them to join in further intergovernmental endeavors, both because they lack money, and also cannot afford to spend too much of the time of their trained personnel in attendance at international meetings.

The Convention Controlling International Trade in Endangered Species (CITES) can be useful to South Pacific nations in their efforts to halt commercial exploitation of their biological resources. It encounters obstacles in the South Pacific because of traditional use of species which may be relatively abundant locally, although threatened or endangered on a global basis. Dugongs in Papua New Guinea and sea turtles in Fiji are examples.

The United Nations Conference on the Law of the Sea has yet to produce an agreed-upon convention. It has a by-product, however, in the proclamation of 200 mile Exclusive Economic Zones in waters surrounding shore-based nations. This has important implications for more effective conservation and management of marine resources in the South Pacific, since it provides for each island nation an oceanic area equal in size to many large continental nations. Acceptance by the international community of the rights of islands nations to benefit from the resources of such EEZ's would do much to provide a more stable economic base for South Pacific countries.

A convention proposed originally by the International Biological Programme (IBP), and drafted by IUCN, concerning the conservation of Islands for Science, may be an effective means for protecting isolated, uninhabited islands from exploitation. Although accepted in principle by the United Nations Conference on the Human Environment (1972), it has yet to come before a plenipotentiary conference of island nations. Several South Pacific countries have indicated a willingness to proclaim islands for science when this convention comes into existence.

3. Problems and action

Decisions on how best to proceed with a plan for conservation are influenced by the urgency of the problem and the feasibility of solving it. Admittedly it is of great urgency to provide the necessary measures to protect and increase populations of threatened species. Without such action irretrievable losses would occur. Nevertheless it may not be immediately feasible to carry out such measures.

The necessary money or expertise may be unavailable, or public attitudes may have to be changed before the required support becomes available. Under such circumstances, it is more worthwhile to devote time to whatever activities can be effective, even though they are less urgent. With these understandings it is possible to list priorities for conservation action under the following headings:

3.1 Action to protect and restore species or biotic communities which are seriously threatened or endangered.

3.2 Action to protect and/or restore critical habitats on which the future of large numbers of individuals or species depend.

3.3. Action to protect representative areas of all biotic communities so that none shall be endangered.

3.4. Action to assure a sustainable yield of all living species which are used for human benefit to prevent future endangerment.

3.5. Action to achieve a balance between human populations and the land or sea resources which sustain them to ensure the long-term survival of all living creatures.

These priorities are influenced by their estimated urgency and feasibility, in particular the time required for their accomplishment. In the first priorities are those actions which could be accomplished in a short period of time. Were it possible to achieve the balance called for under point 3.5 in an equally short time period it would have the highest priority. None of the actions called for under points 3.1 through 3.4 will be permanent in their effect unless those called for under point 3.5 are achieved. In the face of continuing human population growth, and increasing stress on natural resources any conservation achievement would, in time, be overwhelmed.

3.1. Action to protect and restore species or biotic communities which are seriously threatened or endangered.

3.1.1 Species

A threatened species is either one which is in danger of extinction, or likely to become endangered because of low numbers, restricted habitat, or high rates of loss to its populations. If numbers of threatened species alone are considered, the South Pacific does not appear to be in serious straits. But this may only reflect the fact that the South Pacific has fewer species than are to be found in continental areas. In numerical terms the South Pacific has relative few threatened vertebrates - 73 out of the 891 listed in the IUCN Red Data Book in 1977,

including full species and sub-species (geographic races). The number of threatened invertebrates, insects and molluscs in particular, is not known, but is no doubt considerable.

The number of threatened plant species is known to be high, but has yet to be fully tabulated. In part, the small numbers of threatened vertebrates reported to IUCN reflect an inadequate survey and inventory as well as delays in reporting. Thus in recent years new bird species have been discovered in Hawaii, and a new species of lizard in Fiji. Others, perhaps many species, remain to be discovered. The IUCN 1977 tally includes only two kinds of threatened land reptiles in the South Pacific, an elapine snake and an iguana, both in FIji. More recent information indicates that in Fiji alone, 2 species of snakes and 2 iguanas are threatened; and in Tonga, one iguana.

Most of the threatened vertebrate species in the South Pacific are birds, but most of the existing terrestrial vertebrates in the South are birds. Other land animals are severely limited in their eastward distribution, from a center of abundance in Papua New Guinea. Thus, land mammals, except for bats and rats, do not extend eastward beyond the Solomon Islands, and other classes of vertebrates including fresh-water fish show similar limitations.

In table 5 the threatened vertebrates in the South Pacific are listed. This list is incomplete and is compiled from 1977 IUCN reports, country lists, and data reported by Dahl (1976)

It should be emphasized that if a species is stated to be threatened or endangered this statement reflects a biological reality. The species is not likely to survive unless the factors causing the threat are removed or alleviated. Appearance of a threatened species on a national or international list, however, may reflect more than the biological status of the species including the balance of political pressures for or against its protection.

If the distribution of threatened species is considered, the French territories of French Polynesia and New Caledonia lead the list with 21 total threatened taxa and 11 full species. The United States Trust Territories in Micronesia are in second place with 20 taxa and 10 species. For both of these areas the total number of species is small, so that the precentage of the total land fauna that is threatened is high. Thus the Society Islands have only 17 species of land birds, but 5 taxa are threatened; whereas the Marquesas have 9 threatened taxa in a total of 11 endemic bird species. By contrast, the third place on the list is occupied by Papua New Guinea with 10 threatened taxa, all of which are full species. However Papua New Guinea contains more terrestrial species than any other country in the region. The eight threatened species of birds represent a small percentage of the 568 terrestrial bird species in Papua New Guinea. Fiji, in fourth place with 8 taxa and 7 species threatened, lists only 2 land birds out of 67 species resident in the islands. As noted above, however, the list is incomplete, and could be influenced by the distribution of ornithologists as well as the biological realities of species endangerment.

TABLE 5

THREATENED VERTEBRATES

Reptiles

Family Chelonidae

Caretta caretta. Loggerhead turtle
Chelonia mydas. Green turtle
Eretmochelys imbricata. Hawksbill turtle
Lepidochelys olivacea. Olive ridley turtle

Family Dermochelyidae

Dermochelys coriacea. Leatherback turtle

Family Crocodylidae

Crocodylus novaeguineae novaeguineae. New Guinea crocodile
Crocodylus porosus. Salt-water crocodile

Family Iguanidae

Brachlophys fasciatus. Banded Iguana. Fiji
Brachylophus sp. Crested iguana. Fiji
Brachylophus brevicephalus. Tongan iguana. Tonga

Family Boidae

Candoia bibronii. Pacific boa. Fiji

Family Elapidae

Ogmodon vitianus. Fiji snake. Fiji

Amphibians

Family Hylidae

Platymantis vitianus. Tree frog. Fiji

Birds

Family Procellariidae

Pterodroma macgillivrayi. Macgillivray's petrel. Fiji
Puffinus heinrothi. Heinroth's shearwater. Bismarcks

Family Anatidae

Anas oustaleti. Marianas mallard. Marianas
Palau

Family Megapodidae

Megapodius laperouse laperouse. Marianas megapode. Marianas
Megapodius laperouse senex. Palau megapode. Palau

Family Rallidae

Gallinula chloropus guami. Marianas gallinule. Marianas
Pareudiastes sylvestris. San Cristobal Mountain Rail. Solomons
Rallus owstoni. Guam rail. Guam
Rallus poecilopterus. Barred-wing rail. Viti Levu, Fiji
Tricholimnas sylvestris. Lord Howe wood-rail. Lord Howe

Family Rhynochetidae

Rhynochetus jubatus. Kagu. New Caledonia

Family Scolopacidae

Prosobonia cancellatus. Tuamotu sandpiper. Tuamotus

Family Columbidae

Caloenis nicobarica pelewensis. Palau Nicobar pigeon. Carolines
Didunculus strigirostris. Tooth-billed pigeon. Samoa
Drepanoptila holosericea. Cloven-feathered dove. New Caledonia
Ducula aurorae. Society Island pigeon. Society Islands
Ducula galeata. Marquesan pigeon. Marquesas
Ducula goliata. Giant imperial pigeon. New Caledonia
Ducula oceanica ratakensis. Radak micronesian pigeon. Marshalls
Ducula oceanica teraakai. Truk micronesian pigeon. Carolines
Gallicolumba erythroptera. Society Island ground dove. Society Is.
Gallicolumba rubescens. Marquesan ground dove. Marquesas
Ptilinopus huttoni. Rapa fruit dove. Austral Islands
Gallicolumba canifrons. Palau ground dove. Palau

Family Psittacidae

Cyanoramphus novaezelandiae cookii. Norfolk Island parakeet. Norfolk
Eunymphicus cornutus uvaeensis. Uvea horned parakeet. New Caledonia
Vini peruviana. Tahiti lorikeet. Society Is., Cook Is.
Vini ultramarina. Ultramarine lorikeet. Marquesas
Trichoglossus haematodes deplanchei. New Caledonian lorikeet
Vini stepheni. Stephen's lorikeet. Henderson Is.

Family Strigidae

Asio flammeus ponapensis. Ponape short-eared owl. Carolines
Ninox novaeseelandiae squamipila. Norfolk Is. Bookook Owl. Norfolk

Family Alcedinidae

Halcyon cinnamonina cinnamonina. Guam micronesian kingfisher. Guam

Family Muscicapidae

Turdus poliocephalus poliocephalus. Grey-headed blackbird. Norfolk
Acrocephalus caffer aquilonis. Eiao polynesian warbler. Marquesas
Acrocephalus c. longirostris. Moorea polynesian warbler. Society Is.
Acrocephalus c. postremus. Natutu polynesian warbler. Marquesas
Tricocichla rufa ssp. Long-legged warbler. Viti Levu, Fiji
Pomerea dimidiata. Rarotonga flycatcher. Cook Islands
Pomerea iphis fluxa. Eiao flycatcher. Marquesas
Pomerea mendozae mendozae. Hivou flycatcher. Marquesas
Pomera mendozae mira. Uapou flycatcher. Marquesas
Pomera mendozae nakuhivae. Nakuhivan flycatcher. Marquesas
Pomera nigra. Tahiti flycatcher. Society Islands

Family Zosteropidae

Rukia longirostra. Ponape greater white-eye. Carolines
Rukia rukia. Truk greater white-eye. Carolines
Zosterops albogularis. White-breasted silver-eye. Norfolk
Zosterops luteirostris luteirostris. Gizo white-eye. Solomons

Family Estrillidae

Erythrura trichroa pelewensis. Palau blue-faced parrot finch. Palau

Family Sturnidae

Aplonis pelzelni. Ponape mountain starling. Carolines
Aplonis santrovestris. Santo mountain starling. New Hebrides

Family Artamidae

Artamus leucorynchus pelewensis. Palau white-breasted wood-swallow

Family Cracticidae

Strepera graculina crissalis. Lord Howe currawong. Lord Howe Is.

Family Paradiseidae

Epimachus fastosus. Black sickle-billed bird-of-paradise. PNG
Paradisaea rudolphi. Prince Rudolph bird-of-paradise. PNG
Parotia spp. Six-plumed bird-of-paradise. Papua New Guinea
Loria loriae. Loria's bird-of-paradise. Papua New Guinea
Astrapia rothschildi. Rothschild's bird-of-paradise. PNG
Astrapia stephaniae. Stephan's bird-of-paradise. PNG
Pteridophora alberti. King of Saxon Bird-of-paradise. PNG

Family Corvidae

Corvus kubaryi. Marianas crow. Rota, Marianas

Mammals

Family Tachyglossidae

Zaglossus bruijni. Echidna. Papua New Guinea

Family Vespertilionidae

Pteropus mariannus. Fruit bat. Guam, Marianas
Pteropus tokudae. Fruit bat. Guam, Marianas

Family Balaenopteridae

Balaenoptera physalus. Fin whale. Tropical Pacific
Balaenoptera musculus. Blue whale. Tropical Pacific
Megaptera novaengliae. Humpback whale. Tonga, Austral, Fiji

Family Dugongidae

Dungon dugon. Dugong. Papua New Guinea, east to Solomons, Marianas, Carolines

TABLE 6

DISTRIBUTION OF THREATENED TAXA OF VERTEBRATES
(excluding Sea Turtles, Crocodiles
and Cetaceans)

Area	Threatened species	Threatened subspecies	Total taxa
French territories	11	10	21
United States territories	10	10	20
Papua/New Guinea	10	0	10
Fiji	7	1	8
Australian territories	2	4	6
Solomon Islands	2	1	3
Cook Islands	1	1	2
Tonga	1	0	1
Western Samoa	1	0	1
Pitcairn-Henderson (UK)	1	0	1
Vanuatu	1	0	1

TABLE 7

DISTRIBUTION OF SOME ISLANDS BY SIZE AND NUMBER OF NATIVE LAND BIRDS

	Area, sq. km.	No. land bird species
Papua New Guinea	463,476	568
New Caledonia	19,103	68
Fiji	18,200	67
Western Samoa	2,934	30
Society Islands	1,560	17
Mariana Islands	1,027	21
Marquesa Islands	980	11
Tonga	750	15
Norfolk	34	20
Lord Howe	13	15

In planning strategies to protect threatened species one must first consider the reasons why the species are threatened. Unfortunately, in the South Pacific, we find that two of the most universal threats to the future of species are those least amenable to human intervention. These are the size of islands and their degree of isolation.

Biogeographers long ago noted that the number of species that an island will support is in a nearly direct proportion to the size of the island and its distance from a source of species supply such as another island, or ultimately, a continent. Thus, the most remote island in the South Pacific, Easter Island, supported no native vertebrate species, and fewer than 50 species of native plants when it was first settled by humans. As one moves westward across the Pacific the number of vertebrate species increases until on the large island of New Guinea the number of bird species alone is greater than on the Australian continent. At any given distance from a continent, a larger island will normally support more species than a smaller one. This may be influenced, however, by the diversity of environments present on the island - a mountainous island with varied terrain would support more species than a flat atoll of similar size. Thus the Samoan Islands support 30 native species of land birds in a area of 3,131 sq. k., whereas The Tongan Islands, at nearly the same distance from the mainlands support only 15 species in an area of 750 sq k. Norfolk Island, with an area of 34 sq k. supports 20 native land birds, whereas New Caledonia, a similar distance from Australia, but with an area of 19,103 sq. k. supports 68 species.

Not only does the number of species dwindle with decreasing size of an island, but the degree of population stability also declines. Species occupying small islands are more vulnerable to extinction from natural causes as well as human interference. Isolation brings vulnerability to disturbances caused by human agency, since the few species occupying an isolated area will have become less accustomed to the presence of competing species and often totally unaccustomed to predators. If competitors or predators are introduced to an isolated island they are likely to have devastating effects. Furthermore wild species, as well as human populations, on isolated islands will frequently have had no exposure to diseases or parasites common to the mainland. Introduced avian malaria decimated native bird populations on the Hawaiian Islands in the same way that introduced European diseases had devastating effects on human populations throughout Polynesia.

Among the introduced species that have had adverse effects upon native species in the Pacific are the roof rat and Norway rat, feral cats, feral dogs, and mongooses, all of which act as predators on native birds and reptiles. Introduced grazing animals will often have indirect effects on animals through destroying vegetation. Thus, overgrazing by rabbits exterminated 3 of the 5 native land birds on Laysan Island, whereas introduced livestock have had serious effects on the flora and fauna of the Marquesas. A great variety of introduced bird species now exist on many Pacific islands, often exceeding in numbers and variety all of the native species. Asian mynahs and bulbuls are the most conspicuous of these exotics and may compete directly with some native species. Although it is sometimes both possible and desirable to reduce the populations of, or even to exterminate introduced species that are known to have destructive effects, often it is neither physically nor economically feasible.

It would be virtually impossible to exterminate mongooses in Fiji, and extremely difficult to eliminate introduced rats from most islands. Some degree of control is necessary, and, to the extent possible, elimination of introduced species from nature reserves or other protected areas. However, most steps toward conservation must be taken with the realization that introduced species are now part of the ecological reality of island life.

Since a principal purpose of species conservation is the maintenance of genetic variety throughout the planet, it follows that the greatest efforts should be expended toward safeguarding the higher taxonomic categories of animal and plant life, since these represent the greatest extent of genetic differentiation. Thus the dugong is the only species in the only genus in the family Dugongidae. Its closest relatives, the manatees of the Americas and Africa, belong to a different family and show many structural and physiological differences from the dugongs. If the dugong were to become extinct nothing remotely like a dugong would ever be seen on earth again. By contrast the fruit bats, two species of which are listed as threatened, belong to a genus Pteropus which is widespread throughout the Pacific and still relatively abundant. Losing the two species of fruit bats in the Marianas would be unfortunate and a reduction in genetic variety, but the loss would be neither so irreplaceable or overwhelming as the loss of the dugong. Similarly, among the birds loss of the Radak micronesian pigeon in the Marshall Islands should be avoided if possible, but this subspecies of pigeon has close relatives on other islands which are not yet threatened. Loss of the Giant imperial pigeon of New Caledonia would be more serious since this is a distinct species without close relatives elsewhere. However, loss of the kagu of New Caledonia would mean the loss of an entire family and sub-order of birds and a major deduction from the genetic variety of the planet. Viewed in this light the existing efforts to protect the kagu and restore its numbers are obviously inadequate.

Certain priority areas for international attention appear from the above considerations:

> All countries should join in the efforts to protect sea turtles and whales. For the sea turtles, protection of nesting beaches and control over harvesting appear to be the minimum that is required, and complete protection does not appear to be called for at this time, since traditional subsistence uses of sea turtles would not, if controlled, constitute a serious threat. For the whales, however, a complete moratorium on commercial whaling, careful control over subsistence whaling, along with continuing surveys and inventories appear necessary. The example of Australia which has closed its 200 mile economic zone, and Tonga, which has placed a moratorium on whaling, could be followed by other Pacific countries.
>
> Papua New Guinea shuld be given whatever assistence may be required in its continuing efforts to restore and manage dugong populations, and to achieve effective conservation and management of its birds-of-paradise.

Fiji should be provided with any help it requires toward protection of its endangered land birds and reptiles.

Special attention to restoration of land bird populations on Lord Howe and Norfolk Islands is needed.

Land birds in New Caledonia, especially the kagu, are in need of a much more determined effort toward species restoration and conservation.

Other areas where protection of land birds requires a stronger effort are the Caroline Islands, particularly Palau and Ponape; Guam and the Marianas, the Marquesas Islands and the Society Islands.

France, the United States and Australia bear particular responsibility for carrying out conservation action in those areas that still remain under their jurisdiction.

3.1.2 Biotic communities

Considering population growth, pressures on land, and demand for conventional economic development in the South Pacific, it can be said that all native biotic communities which have developed in the absence of frequent or intensive disturbance by human agencies are to some degree threatened, unless specific steps have been taken to safeguard them. Nowhere in the South Pacific have the measures been taken which are needed to safeguard the existence of natural communities, although some parks and reserves have been established. The danger to unique biotic communities, most of which include endemic and rare species is greater on small islands than on large. Thus the rain forests of Papua New Guinea are relatively secure, whereas those of the Tuamotus have largely disappeared. Western Samoa, Fiji, Solomon Islands and New Hebrides still have extensive rain forests, mostly montane. On Tonga only outlying forests on smaller islands remain intact. The forests of the Cook Islands and Society Islands are greatly disturbed. It cannot be said that the Indo-Pacific lowland rain forest community which extends from New Guinea to Pitcairn is immediately threatened in its totalilty. But local varieties of it are near total destruction. Most biotic communities have the potential to suppy natural resources for human use over the foreseeable future without losing their capacity for regrowth and self-renewal. But none can stand up to the massive impacts of commercial logging to meet an insatiable export market, massive land clearing for agricultural or residential purposes, or the other pressures to which increasingly industrialized societies can subject them.

It seems most likely that highly complex and diversified communities such as the tropical rain forests cannot be protected in small reserves, but require either large areas - perhaps hundreds of square kilometers - or interconnected networks of smaller areas if they are to survive intact. Only in the larger western islands, from Western Samoa and Fiji, through New Hebrides and the Solomons to Papua New Guinea is it possible to establish such large protected areas. No reserves of adequate size now exist in the South Pacific.

The following specific biotic communities are known to be seriously threatened and to require protective measures. In some cases partial protection has been provided - reserves which are not policed or patrolled, but additional safeguards are necessary.

Araucaria, a genus of Southern Hemisphere conifer, includes a number of endemic species on New Caledonia and Norfolk Island. Some protection exists on New Caledonia, but larger and more completely protected reserves are needed in both countries.

Agathis, the kauri pine, in the same family as Araucaria is under pressure particularly in Vanuatu and New Caledonia. Some protection exists, but more adequate protection is needed.

Sandalwood, Santalum, forests have long been under serious pressure throughout the Pacific and have been destroyed in many countries. Protection is required particularly on Henderson Island and in the Loyalty Islands.

Palm forests of Neoveitchia and Goniocaldus on Fiji require protection.

Palm forest of Pelgodoxa on Nuku Hiva in the Marquesas requires protection.

The limestone forest of Huvalu in Niue should be given protected reserve status. (It is under traditional tribal protection.)

The limestone forest of Ritidian in Guam requires protection.

The primary forest of Semecarpus, Clinostigma and Ficus in Truk is threatened and needs protection.

Any biotic community supporting and providing a principal habitat for any endangered or threatened species of animal or plant should receive special protection.

Marine biotic communities supporting the giant clam, Tridacna gigas, which has been exterminated in many areas of Micronesia should receive special protection.

The list is by no means complete. Surveys are not only incomplete for the region, but in some areas have scarcely begun. Many other threatened communities may be found.

Particular attention should be given to the biotic communities of the still uninhabited islands of the South Pacific, since in many instances these have been relatively free from disturbance. This applies more to the elevated limestone islands than to the sand cays, many of which have been converted to coconut plantations. It has been recommended by the International Biological Programme that these undisturbed islands, be set aside as strict scientific reserves. If the convention to protect "Islands for Science" is adopted, these islands are candidates for such protection. Among those mentioned in this category are the northern Marianas from Farallon de Medinilla to Uracas; five small Caroline

islands; the Marshall islands of Taongi and Bikar; the Phoenix islands of Phoenix, Birnie and McKean; the Line islands of Howland, Jarvis, Malden, Vostok and Kingman Reef; the American Samoan island of Rose Atoll; the Cook Island of Suvarov, Oeno, Henderson and Ducie islands in the Pitcairns; Ata, Falcon Island, Minerva Reef in Tonga; and Taiaro atoll in the Tuamotus. Table 6.

In recommending action one must balance urgency and feasibility. Thus it is most urgent to provide protection for those endangered communities which have been identified. It is probably much less urgent to protect the "islands for science" since these are less likely to be disturbed. However, it is relatively easy to provide protection for isolated, uninhabited islands, and usually much less so to protect communities that are endangered because of ongoing human activities. Bearing in mind that both tasks should be accomplished, governments should proceed as local circumstances dictate. American Samoa has already protected Rose Atoll, whereas the Cook Island government has offered Suvarov as an island for science and no doubt will protect it insofar as is possible. France has established a Scientific Reserve on Taiaro Atoll.

Often the best protection to be afforded to an endangered biotic community is the strict and total protection of a strict scientific reserve from which all disturbance is excluded including public visitation. Such a concept, however, may not easily be sold in countries where few people have any interest in or knowledge of "Science" in the European sense. Some combination of permitted uses which are of direct interest and value to the people immediately concerned, but unlikely to conflict with the main purpose of nature protection is most likely to be advisable in reserves set aside to protect biotic communities. However, some types of bitic communities can best be protected by a change in management practices, such as modification of forest management, and others may require a vigorous program of propagation and habitat modification not suitable to a protected reserve.

Islands to be selected as international scientific reserves need to be carefully screened to ascertain whether or not the same objectives could be accomplished by other, less exclusive forms of protection. Thus Henderson Island in the Pitcairns is the home of a unique and still largely undisturbed biotic community with many endemic species of plants and land birds. It would seem to deserve the long-term international protection to be afforded an island for science. However many of the bird atolls in Kiribati may require only protection from egg collectors during the breeding season and have limited long-term scientific value. It should be noted that any degree of protection for remote islands will require international cooperation.

4. Action to protect and/or restore critical habitats on which the future of large numbers of individuals or species depend.

Marine ecosystems are more open than terrestrial systems and are affected by continuous interaction of sea, air and land, with frequent mixing of marine waters both vertically (upwelling, convergence) and horizontally (surface and deep currents). In one sense the Pacific Ocean is a single, large ecosystem and attention must be given to all of it.

TABLE 8

INININHABITED ISLANDS OF SCIENTIFIC INTEREST
AS RESERVES OR ISLANDS FOR SCIENCE

Island Group	Island	Area	Characteristics	Jurisdiction
Mariana Is.	Uracas	0.8 $mile^2$	Active volcano	USA
	Maug	0.8 $mile^2$	Volcanic	USA
	Guguan	1.6 $mile^2$	Active volcano	USA
	Farallon de		Raised lime-	USA
	Medinilla	0.3 $mile^2$	stone	USA
Caroline Is.	Gaferut	0.04 $mile^2$	Atoll, Seabirds	USA
	Helen Reef	0.8 $mile^2$	Atoll	USA
	East Fayu	0.2 $mile^2$	Atoll, Seabirds	USA
	West Fayu	0.02 $mile^2$	Atoll	USA
	Pikelot			
Marshall Is.	Taongi	1.3 $mile^2$	Atoll, Seabirds	USA
	Bikar	0.2 $mile^2$	Atoll, Seabirds	USA
Phoenix Is.	Birnie	1.0 km^2	Atoll, Seabirds	Kiribati
	Phoenix	0.2 $mile^2$	Atoll, Seabirds	Kiribati
	McKean	0.2 $mile^2$	Atoll, Seabirds	Kiribati
Line Is.	Howland	0.7 $mile^2$	Atoll, Seabirds	Kiribati
	Jarvis	1.8 $mile^2$	Atoll, Seabirds	Kiribati
	Malden	11.3 $mile^2$	Atoll, Seabirds	Kiribati
	Vostok	0.1 $mile^2$	Atoll, Seabirds	Kiribati
	Kingman Reef	0.1 $mile^2$	Reef, Marine	Kiribati
Cook Islands	Suvarov	0.2 $mile^2$	Atoll	Cook Is.
Samoa	Rose Atoll	0.1 $mile^2$	Atoll	USA
Tonga	Ata	1.0 $mile^2$	Volcanic, seabirds	Tonga
	Falcon Is.		Active volcano (submarine)	Tonga
	Minerva Reef		Reef, marine	Tonga
Tuamotus	Taiaro Atoll		Protected reserve	France
Marquesas	Hatutu	7.0 $mile^2$	Volcanic	France
Pitcairn Is.	Ducie	0.3 $mile^2$	Atoll	UK
	Henderson	11.0 $mile^2$	Land birds, endemics	UK
	Oeno	0.3 $mile^2$	Atoll	UK

Since this is virtually impossible, concentration must necessarily go to those areas which are most vulnerable or most readily damaged by human activities. Those areas of the ocean closer to land receive more impact from human activities than the open ocean. The effects of shore-based pollution will be felt more quickly in a coral reef community or a sea-grass bed than among the inhabitants of the bathyal plain. Focussing attention on such critical habitats, therefore is a question of priority and does not imply that other parts of the ecosystem can be ignored and neglected. Attention to the processes which affect the critical habitat will be as essential as attention to the habitat itself.

The marine environment of the South Pacific is not highly productive. Much of it has been compared to a continental desert. Two reasons for the low productivity of the region are the absence of a continental shelf, excepting the Australia and New Guinea area, and the absence of any extensive area of upwelling. Continental shelves, the shallow, submerged fringes of continents, tend to support an abundance of marine life and help supply nutrients to more distant ocean areas. Areas of upwelling, where deep, nutrient rich ocean waters are brought to the surface, are the sites of some of the world's most important fisheries.

A major geological feature of the South Pacific is the presence of some of the world's deepest oceanic trenches. These are the meeting grounds of the plates of the earth's surface, on which the continents ride. The South Pacific trenches tend to separate the continental type of island which lies to the westward from the oceanic islands of volcanic origin, including those coral atolls perched on submerged volcanic peaks, which lie eastward. The Tonga-Kermadec trenches, running from New Zealand eastward of Tonga and cutting in to the south of the Samoan islands; The Vityaz, New Hebrides and New Britain trenches, which form a northern boundary to the Melanesian islands, and the Yap and Marianas trenches, including the world's greatest ocean deep, which lie eastward of the Marianas and western Carolines essentially separate the more productive areas of greater marine faunal diversification from the less productive, less diversified areas of the Pacific plate. North and east of these trenches islands tend to be steep sided, lagoons and island slopes limited in extent. The trenches themselves are of great biological interest since they support a fauna tolerant of the absence of light, extreme pressure and other physical features of ocean depths. They would not be threatened by ordinary human activity, but have been suggested as "safe" dumping grounds for some of the industrial world's most dangerous waste products. Since there is no evidence that these deep waters do not mix with surrounding ocean waters, such dumping could endanger more than the fauna of the marine trenches.

In view of the low productivity of most of the South Pacific ocean, the areas designated as critical marine habitats become of unusual significance since these include some of the most productive areas of the world's oceans. These areas include:

5.1. Coral reefs
5.2. Mangrove forests
5.3. Sea grass beds
5.4. Estuaries
5.5. Sea bird rookeries
5.6. Sea turtle beaches
5.7. Marine mammals breeding areas.

4.1. Coral reefs

Coral reefs are calcareous structures found in shallow tropical waters which are actively constructed and maintained through deposition by coral animals, coralline algae, and other calcium-depositing organisms. Reefs may be dominated by either corals or algae (algal reefs). They may be of the atoll variety, more or less circular and surrounding an interior lagoon; barrier reefs, offshore from major land masses and separated from them by lagoons or channels; fringing reefs, which grow directly out from the shore of land masses; and lagoon or patch reefs which develop in waters sheltered by major reef structures. To quote Bernard Salvat:

"While the oceans themselves are relatively barren, however, the coastal areas have great richness in coral. The coral communities which surround these islands are among the most productive ecosystems on earth. This extraordinary contrast demands explanation. The coral reef ecosystem is itself the most remarkable instance of symbiosis between animals (The madrepores and some other organisms) and algae, which inhabit their tissues. The whole food web of these isolated ecosystems depends on these algae trapped by animals, and analagous in other respects to the free algae which are the phytoplankton of the oceans. An important consequence of this symbiosis is that energy losses between trophic levels are reduced to a minimum. Moreover, the coral community has developed mechanisms with which to supply itself with indispensable nitrogen and to recycle acquired phosphorus, within a larger oceanic environment characterized by extreme poverty in these elements. In addition, the mucus and detritus created by these symbiotic algae are fundamental to all trophic interrelationships among the coral communities. The richness of this community is thus a remarkable natural adaptation to a quasi-desertic environment."

Thus coral reefs are not only one of the most productive and diversified habitats on earth, supporting for examples hundreds of species of marine fish and molluscs, but they are the source of nutrients to all downstream areas to which currents carry their nutrient-rich waters. If reefs are protected then near shore waters will continue to supply an abundance of fish, shellfish, crustacea and other living marine resources to human populations. If reefs are destroyed these benefits are lost. Reefs furthermore provide physical protection for islands which would otherwise be battered and washed away by continued wave action, storms, and hurricanes.

Coral reefs are found in all biotic provinces of the South Pacific, reaching their southernmost limit at Lord Howe Island.

The threats to coral reefs are numerous. Coral is a common source of building materials (stone and lime) and reefs are sometimes destroyed to obtain these. Near urban centers or areas of intensive agriculture where pesticides are employed pollution becomes a serious problem. Erosion from upstream sources, such as recently logged-over slopes, unprotected agricultural soils; or construction sites can result in siltation which covers and smothers reefs. Similar effects can come from dredging of harbors and channels. Where copper or nickel are mined, as in Bougainville, New Caledonia, and potentially in the future in Fiji, not

only siltation resulting from erosion of open-cast mining sites, but toxic metal poisoning may destroy reefs. Reefs are also damaged by collectors of corals, shells, and fish. Toxic substances used to kill fish, for examples bleach or pesticides, will destroy reef organisms.

To add to these man-made troubles, destruction of reefs through outbreaks of the crown-of-thorn starfish (Acanthaster) has occurred in a number of South Pacific areas.

The actions required for coral reef protection are several. All living coral reefs should be protected against coral mining, pollution, siltation and excessive collecting. This requires not only the passage of the necessary laws to protect reefs - and with them other living resources, but a willingness and ability to enforce laws, even against politically powerful industrial polluters. Laws and law enforcement will in turn be powerless unless accompanied by a program of public awareness and education which will bring an acceptance of the need for legislation and a willingness to abide by it.

Along with general protective measures, marine reserves and marine national parks are required in every island nation. These can serve as a reservoir and source of supply of species which elsewhere become depleted. They can play a significant role in programs of public education and awareness, and they have an inestimable scientific and ecological value. Reserves have been created in New Caledonia, French Polynesia, Tonga, Papua New Guinea, Fiji and Micronesia and additional reserves are planned for those countries. Measures are being taken to create marine reserves in Western Samoa and the Cook Islands. Re-establishment of traditional conservation practices and re-enforcement of customary rights over reef and lagoon areas can sometimes play a greater role for coral reef protection than the establishment of formal reserves. To assist in either activity, guidelines for the establishment, protection and management of marine reserves should be made widely available to Pacific countries.

4.2. Mangrove forests

Mangrove forests are made up of broad-leaved, hard-leaved trees and shrubs such as Rhizophora and Avicennia which occur in the intertidal zone along tropical shores and in estuaries. The mangroves are characterized either by stilt roots or pneumatophores and are areas of accumulation of silt and sand, resulting in associated mud flats. Mangrove areas are one of the most productive habitats in the South Pacific. Not only do they support a variety of fish and shellfish, particularly the more vulnerable juveniles of a variety of species, but they also contribute nutrients to waters downstream and support additional productivity in these waters.

Mangroves provide roosting, shelter, and nesting areas for a wide variety of aquatic birds. They have, along with coral reefs, a direct physical role in island protection since they mitigate the force of winds and waves which would otherwise be more destructive to inland areas. Because mangroves accumulate silt and organic debris they can have an important role in pollution control. In some areas of the world mangrove areas

have been developed through elevated nature trails and boat trails into sites of considerable interest to tourists as well as local people.

Mangroves are best developed in the western area of the South Pacific. They are well developed in the Marianas and western Carolines, but are infrequent in the Marshall Islands. Norfolk and Lord Howe Islands lack mangroves, nor are they reported by Dahl (1976) or Douglas (1969) for the Phoenix, Line or Cook Islands. In French Polynesia they are reported in the Tuamotus, but not elsewhere, by Dahl and Douglas. However Stoddart (1975) states "Of particular significance is the absence of mangroves from the Cook Islands. Six species in the genera Rhizophora, Bruguiera, Limnitzera and Xylocarpus are recorded from Tonga (Yuncker, 1959) and three from Samoa in the genera Rhizophora, Bruguiera and Xylocarpus (Setchell, 1924). They are also absent from the Society Islands and the Tuamotus and other eastern and northern Pacific atolls, including the Tokelaus (through introduced in Hawaii and Tahiti). Their absence indicates an important vegetational and sedimentary difference between the Cooks and the islands of the west Pacific."

Mangroves occupy the edges of lagoons and harbors where human settlements are often concentrated. They also occur along coastal strands in areas that seem otherwise attractive as building sites. Consequently mangroves are subject to destruction through dredging, clearing and land filling on many populated islands. They are frequently cut for firewood, construction materials and tanning materials. Hostility toward mangroves is associated with their relative impenetrability and the fact that they serve as breeding areas for mosquitoes. Their negative values are obvious, their usefulness as a source of raw materials is apparent, but their positive values as an intact, functioning community are apparent only to those who have studied them. In consequence they are often destroyed. (Baines, 1979).

Surveys of mangroves in the western Pacific are needed to identify those areas most important for their contributions to biotic diversity and marine productivity. Some of these areas should be established as protected reserves. Most mangrove areas should be protected against clearing, filling, or dredging unless compelling reasons are found for excepting some sites for other uses.

4.3. Sea grass beds

Sea grass beds are occupied by true grasses of such genera as Thalassia and Malophila which occupy the lower intertidal and subtidal zones along coast lines. They occur throughout the western islands and Micronesia. They are not reported by Dahl (1976) for Lord Howe or Norfolk or in the area east of the Samoan-Tongan islands. They provide highly productive feeding grounds for dugongs and sea turtles, and serve as important nursery grounds for a great number of fish and shellfish.

Along with mangroves sea-grass beds are affected by the lack of any general public understanding of their value or importance. They are subject therefore to the same problems of dredging and land filling, siltation resulting from these activities or from upstream erosion, and excessive pollution.

Surveys are needed to identify the most productive areas as sites for marine reserves or other special protective measures. Legislation to control development in the coastal zone with control of dredging, filling and related siltation as well as control over the discharge of pollutants is necessary for the long range protection of sea grasses.

4.4. Estuaries

Estuaries occur wherever streams enter the ocean along a gentle gradient. They are characterized by gradients in salinity from fresh to salt water and by fluctuating salinities resulting from variable stream discharge and tidal movements. They provide a habitat for species adapted to salinity ranges and fluctuations, and are in important source of nutrients for downstream marine areas. In the western Pacific they are habitats for mangroves and sea grasses. Elsewhere their margins are occupied by salt marshes. They provide support for many kinds of fish and shell-fish along with dugongs, crocodiles, waterfowl and shore birds. They are particularly important as resting and feeding grounds for migratory waterfowl and shorebirds.

The problems of estuaries are the same as those confronting mangroves and sea-grass beds. Pollution, siltation, dredging and filling are common disturbances.

Coastal zone legislation to regulate land and water use and to control pollution and siltation is essential to estuarine conservation. Where species or communities of particular interest or value occur, reserves may be important for their conservation.

4.5. Sea bird rookeries

Sea-bird rookeries are areas with a high concentration of nesting sea birds. They were originally found along the shores of many islands, but are now largely confined to small, uninhabited islands, offshore islets and rocks. Some seabirds, such as the white-tailed tropic bird, nest inland in cliffs or cavities within rainforest communities.

Although rookery islands are distributed throughout the Pacific, some islands are exceptionally important. Christmas Island in the Line Islands supports 20 or more breeding species of sea birds, and most of the other Line and Phoenix islands are reported to be important sea bird rookeries. In the Marshall Islands, Taongi has 18 possible breeding species, whereas Bikar, Eniwetok, and Jaluit have 15 - 16 possible breeding species. In the Gilbert Islands, Makin, Honouti, and Onotoa each support a possible 12 breeding species. The Chesterfield Islands, Rose Atoll in Samoa, the northern Marianas, and Gafrut, East Fayu, and Helen's Reef in the Carolines are important sea bird areas. Ata in Tonga, the northern Lau and northern Kandavu islands in Fiji, have been noted as important sea bird colonies along with Henderson and Ducie islands in the Pitcairns. Undoubtedly the list could be much longer, since surveys are not complete. Approximately 40 species of sea birds breed within the region with many millions of individuals.

Sea bird eggs have traditionally formed part of the diet of many South Pacific peoples, and the meat of certain species is also eaten. Plumes of some species are valued. All sea birds are of great scientific interest, and the rookeries can be important attractions for natural-history oriented tourism.

Over-collecting of eggs and disturbance of breeding colonies can reduce sea-birds drastically. Introduced predators can create serious problems particularly among ground-nesting birds, and in this category the roof rat and Norway rat are probably most important. Feral house cats and mongooses are problems in some islands, as are domestic hogs and dogs. In recent years the widespread use of organochlorine pesticides has caused nesting failures among some species of sea birds.

Protection of sea birds requires protection of the nesting sites from disturbance and regulating of egg collecting. Most such sites were traditionally protected in the past, but with the breakdown of cultures and the rise of commercialization such protection is no longer reliable. In Kiribati, wardens are now employed to safeguard rookeries in the Line Islands and to regulate egg collecting. They are also engaged in a public education program. Similar action is probably needed elsewhere. Protection of the rookeries themselves may not be enough if feeding areas for the nesting birds become depleted. In California protection is afforded to marine areas surrounding rookeries during the nesting season, and fishing is prohibited in these waters. Similar action may be required in the South Pacific where important rookeries exist in heavily fished regions of the ocean, however no such serious competition between sea birds and island fisheries has been noted at this time. A more serious problem may exist with pelagic fisheries where sea birds become entangled in fish nets, but the extent of loss to this cause is not known.

4.6. Sea turtle beaches

According to Dahl (1976) sea turtle nesting beaches occur throughout the South Pacific with the exception of the Norfolk-Lord Howe-Kermadec province, the Marquesas, and the Pitcairn-Gambier-Rapa province. Two species, the hawksbill and green turtles are the most common nesting species in the region. Distribution of ridley, loggerhead and leatherback turtles needs further investigation. Not enough is known about the relative importance of the various islands and beaches as turtle nesting grounds. In Micronesia, for example, Pritchard (1977) found that the island of Bikar in the Marshalls was exceptionally important as a nesting area, along with Helen's Reef and Merir in the Palau district.

Sea turtles are important economically to people in the South Pacific as sources of eggs, meat, and various products derived from their carapaces. The scientific interest in sea turtles is high, since these, along with the sea snake, *Pelamis*, are the only truly pelagic marine reptiles and many of the characteristics of their migrations and life cycles are still unknown.

The greatest threat to sea turtles comes from overexploitation of both eggs and adults, and from disturbance to nesting beaches in some areas. Subsistence use of sea turtle eggs and meat requires regulation. Commercial trade in sea turtle products probably needs to be eliminated until such time as turtles recover to safe numbers. Protection of nesting beaches is required primarily during the breeding season, although any form of use, such as sand mining, residential construction, urban-industrial development, transportation development, which would be disruptive to the nesting beaches should be avoided.

As a first step survey and mapping of the major turtle beaches is required. Measures need then to be taken to protect the more important areas during the nesting season. A further step has been taken in Western Samoa, where young turtles are reared to an age at which they are more likely to survive the hazards of life at sea, and then released at their original nesting beach. The success of these measures still requires evaluation. A further step would be mariculture, in which turtles are reared in protected waters through all vulnerable stages of their life cycle. However, this is believed by Pritchard to be inadvisable so long as natural breeding populations exists.

4.7. Marine mammal breeding areas

All areas where marine mammals concentrate for breeding need to be protected. To date, however, only one significant concentration area has been located, the humpback whale breeding ground in the Tonga seas. Potential breeding concentrations of humpback whales may be found in Fijian waters and also around the Austral islands. All such breeding areas should be declared against disturbance and exploitation. This further protection should be in addition to a moratorium on whaling within the exclusive economic zones surrounding all island nations. At such time as whale population recover it may once again be possible to discuss reasonable levels of exploitation. At present it is not.

5. Action to protect representative areas of all biotic communities so that none shall be endangered

Essentially the information to be considered under this heading is much the same as under 4.1.2. Not all biotic communities in the South Pacific are threatened. Given the continuation of present trends, all could be in very few decades. To safeguard the genetic basis of life in the South Pacific it is important to protect at least representative areas of all communities. It is much easier to do this now before these communities are threatened than it will be later when the pressure of population and economic demand has increased. What is required is a network of national parks, nature reserves, biosphere reserves or other protected areas throughout the Pacific region. Ideally these should represent around 10 per cent of the total land area, and probably a similar percentage of reefs and lagoon areas. The system should include isolated and uninhabited islands along with representative reserves on larger, inhabited islands. On some of the more densely populated islands,

representataive areas of natural vegetation and animal life can no longer be found. The most representative areas on islands not yet greatly affected by human activity should be sought out and protected.

The value of protecting already degraded areas within the reserve network should also be considered. Many such areas can recover with a reasonable degree of conservation.

An example of an approach to establishing protected areas could be taken from the Marshall Islands. In 1969 Amerson reported on a bird survey of the 32 atolls in this group. In 1977, Pritchard reported on turtle populations. Eleven of the 32 atolls were uninhabited, but all of these were visited by people from other islands seeking copra, sea bird eggs, turtles or other provender. Five of these atolls: Taongi, Bikar, Take, Jemo, and Erikub are important nesting areas for green turtles. These uninhabited atolls each support from 14 to 26 bird species. They have been traditional reserves maintained by custom by the Marshallese people, and two of them, Taongi and Bikar have been declared as protected areas by the United States authorities. Continuation of reserve status for these atolls would appear to be a logical step for the people of the Marshalls. It would not, however, serve to protect representative areas of vegetation for the entire island chain. For this purpose some of the inhabited atolls, notably Maloelap, Arno, Eniwetok, Rongelap and Ebon should be examined to find suitable natural areas. The uninhabited atoll of Rongerik, which has considerable natural vegetation could also be considered for reserve status. If approximately 18 sq. kilometers out of the roughly 180 sq. k. of dry land in the Marshalls - 10 on uninhabited atolls, and 8 on inhabited, were set aside, the most important bird colonies, the principle turtle beaches and representative areas of most terrestrial vegetation would be protected along with significant areas of reefs and lagoons.

In Western Samoa the new national park of O le Pupu-Pue, in Tonga the new park on the island of Eua, and in Fiji the nature reserve on Taveuni are examples of reserves that extend from mountain tops to the ocean and provide a cross section through the altitudinal distribution of vegetation and thence into the near-shore marine environment. Such reserves, which can serve to protect representative areas of most island biotic communities are to be recommended for other areas.

An examination of table 3 will show the rather overwhelming obstacles faced by some islands which may wish to protect representative natural areas. Low density populations, less than 15 per sq. k. in Papua New Guinea, Solomon Islands, New Caledonia, Vanuatu, and Niue permit considerable freedom of choice in selecting areas for reserves. Even the lower middle range of densities of Fiji, French Polynesia, Western Samoa and Micronesia still leaves much open space and uninhabited land. The level of crowding in Tonga, Kiribati, the Cook Islands and American Samoa creates more serious problems, but because populations are not evenly distributed all of those countries have been able to set aside reserves on some islands. With the high population densities of Tuvalu and Nauru, the possibility of creating terrestrial reserves of more than token size has vanished, although marine reserves remain a possibility.

6. Action to assure a sustainable yield of all living species which are used for human benefit to prevent future endangerment

The concept that any population of animals or plants can produce a yield or crop for human benefit has been known to most people probably since the earliest times.

The concept that there are limits to the crop that can be taken, and these are governed by the ability of that population to produce young and the survival capability of those young has been known to all people who lived close to the Land and depended on it for a livelihood. The idea that it is possible to exploit a population beyond its capacity to produce has also been known to raiders, invaders, colonialists and imperialists of all kinds since the first human band began exploitation of other human bands. It is associated with a lack of responsibility for the people, land, and resources being exploited, and a desire only to enrich the people and territory of the exploiting group. Unfortunately, the first two of these concepts have been lost sight of and the third idea dominates in todays world with the result that people behave as raiders and exploiters even of their own lands. As a result, forests which could produce reasonable yields forever are destroyed for an immediate profit; farming lands are pushed beyond their limits until fertility is exhausted or erosion takes the soil away; and wild species are driven closer to extinction. One could profitably speculate on the reasons for this behavior, but the important thing is to correct it.

To restore the practice of maintaining cropping and other forms of use within sustainable limits it is now necessary to rediscover old knowledge and educate people to an understanding of old rules. This now requires an expensive program of research and education - research to discover levels of population and limits to possible use, and education to make people aware of those levels and limits. Any people who hope to survive in lands that they now occupy must carry out such research and education. For the small islands - the crowded countries - the need for this is most urgent. The larger, sparsely populated islands have a little more time.

7. Action to achieve a balance between human populations and the land or sea resources which sustain them to ensure the long-term survival of all living creatures

This action follows on the above, but brings with it a further recognition of limits and of interdependence between humankind and all other forms of life on earth. Recognition of limits brings with it the realization that human populations on small islands must limit their reproduction or face the threat of collapse. Some islands are already overpopulated and one of the more serious problems they could face would be the return of their expatriate populations. But there are limits also on the capacity of other countries to absorb surplus populations from the Pacific Islands.

The need to achieve self-reliance, and if possible self-sufficiency in those areas necessary to human survival has become increasingly obvious to the governments of the South Pacific and is reflected in the draft "Comprehensive Environmental Management Programme" circulated by the South Pacific Commission and the South Pacific Bureau of Economic Cooperation which has been accepted in principle by the representatives of island governments as a background document for the South Pacific Regional Environment Programme. This document also emphasizes the need for reestablishing a symbiosis between humankind and nature in the Pacific, for a new realization of the interdependence among living species including the human species.

Future planning for any nation should always include recognition of the worst imaginable eventualitites, and in today's world the imaginable worst can be very bad indeed. The need for Pacific countries to develop the capacity, which once they all shared, of self-sufficiency should be apparent. To have any hope of this - the resources of the seas and the productive capacity of the lands must be maintained and today's economic gains must not be bought at the expense of tomorrow's survival. Viewed from this perspective, nature conservation is simply common sense.

8. How to Proceed

8.1 Conservation education and public awareness

There are many urgent conservation problems in the South Pacific and at times it may appear that action must be taken at once on all of them. This is not feasible, and if it were it would still not succeed unless a background of public awareness and appreciation of conservation needs is created. This involves not just education in the schools but public programs of one kind or another: Arbor Day in Western Samoa or conservation Week in Fiji being examples - that make use of all available media and methods.

Even the background materials for public education and awareness programs are not available to most Pacific countries. There are usually no guides to the local fauna or flora, no collections, no museums, no books that are relevant or materials of any kind. In Tonga, for example, there is a privately owned collection of native birds in the principal tourist hotel. One wonders how many Tongans know it is there? In Western Samoa there is no such collection, anywhere. In Fiji there are at least useful bird guides and the Fiji Museum plays an active role in public education, but it is poorly endowed and supported and most of the materials it should have are in museums overseas. Scientific imperialism has taken its toll in the Pacific, with the result that the local people and their representatives would have to travel to London, Canberra, Paris, Wellington or Hawaii to see the specimens collected from their own countries. Furthermore the scientific publications which are concerned with the Pacific are usually not available in the Pacific countries, and the governments and private institutions can scarcely afford to purchase them.

It is difficult to educate children to an awareness of their own environment when the school books are addressed to other children in New Zealand, Australia, America or Europe. In this connection, the Green Book of Fiji, prepared for the National Trust with IUCN/WWF support is a useful step forward. But there should be other Green Books, for all the countries.

Conservation education and public awareness are a responsibility of local governments, but with few exceptions (Nauru, for example), they cannot afford their own programs. International assistance is necessary, and this deserves high priority. Just as a first step, governments that support conservation field projects of one kind or another in the Pacific could see that their representatives are supplied with copies of the relevant publications from their own agencies, and that these are donated to the appropriate island libraries.

Non-governmental agencies have a similar responsibility, and it is not sufficient to send price lists to the countries concerned - they need free publications. It is probably premature to request that plant and animal specimens collected in the Pacific should be returned to the countries which have supplied them. First the appropriate museums, herbaria, arboretums, and similar facilities must be established. However, future expeditions involved in collecting biological specimens should see that duplicate specimens and copies of all available reports are made available to the host countries.

8.2 Survey and inventories

The need for appropriate surveys and inventories has been stressed throughout this report. It is easy to forget how large an area is involved in the South Pacific and how difficult it is to travel from place to place. Fiji, for example, has more than 400 islands. The National Trust staff, based on one island has transportation equipment amounting to one jeep. In Tonga, the national parks staff has one small boat and a bicycle, but the islands of Tonga stretch over nearly 10 degrees of latitude. Planes can't land on most islands and ships visit them infrequently. It is virtually impossible for local conservation authorities to know what is going on in the areas for which they are responsible.

A first step toward achieving a knowledge of the distribution and abundance of species and communities would be to make a biological research vessel, capable of spending months at sea and travel from island to island, available at least periodically to the conservation staffs in South Pacific countries. Two or three such vessels, assigned to the South Pacific, and staffed with trained marine and terrestrial biologists, could travel from country to country, spending a few months in each place and carrying out tasks deemed most urgent by the local conservation authorities.

IUCN has developed, through its critical marine habitats project, a method of integrated surveys which has proved useful in the Arctic and the Caribbean. This makes use of satellite imagery, aerial photography, and other data from existing sources to prepare analytical maps of

critical habitats, threatened species habitats, and other biotic communities, along with the economic, political, social and ecological processes affecting them. They serve to identify areas of greatest conservation value and also areas of potential or existing conflict between conservation and other demands. The research vessels and their staff, described above, should be trained and equipped to employ these techniques for the benefit of South Pacific countries.

Because it is too often forgotten by scientists and others who visit the South Pacific, the object of surveys and inventories is to make knowledge available to the countries of the South Pacific, and not simply to enrich the knowledge of visiting scientists. Any such surveys should include as an essential component the training of local personnel, so that each country will develop its own expertise and no longer need rely on outsiders to do its scientific work. Similarly research vessels should be provided with the understanding that these or similar vessels will be made available to the appropriate South Pacific regional agency. Otherwise a further condition of dependency is created, not much better than those which have prevailed in the past.

8.3. Legislation and law enforcement

Although many South Pacific countries have various sorts of conservation legislation, few have developed an overall legislative framework and administrative organization that permits continuing environmental protection and conservation of natural resources. International assistance should be provided, upon request, to assist with the formulation of conservation legislation and to help in developing appropriate administrative frameworks.

Law enforcement is generally inadequate throughout the Pacific since even the existence of conservation legislation is often not known to the people of the countries concerned. Some forms of law enforcement can only be conducted within each country and require a trained national warden force, or their equivalent. However, to patrol and protect the many remote islands of the South Pacific, some sort of regional patrol force appears to be required, with the ability to apprehend law breakers without regard for their country of origin. The creation of a regional fisheries agency could be a step in this direction, but only if it does not restrict its concern to fishing, and its rule is extended to include monitoring and control.

International assistance may be required for the training of personnel who will have a joint responsibility for supervising and enforcing conservation legislation as well as carrying out education and public awareness activities. Eventually a regional training center would be more appropriate than the present pratice of depending on countries with greatly different social and environmental conditions to provide the training.

8.4 Continuing existing activities

Few countries in the South Pacific are addressing the problems of conservation for the first time. Most have some sort of program underway

to identify and establish reserves, to protect exploited or threatened species and to carry out public education. Wherever viable programs are underway they should be given whatever support is needed to keep them going, and, when and where possible, to strengthen them. Where no strong programs exist, and this is true in Vanuatu, the Solomons and Niue, then international agencies should be prepared to give the necessary push, to provide the experts and some funds to start such activities and keep them going. This paper is a guide to some of the activities that are needed. The people of the South Pacific and their governments have the responsibility and are in the best position to know what will work best under the conditions that they face.

REFERENCES

Amerson, A. B., 1969. Ornithology of the Marshall and Gilbert Islands. Atoll Research Bul. 127.

Baines, G.B.K., 1979. Mangroves for national development: a report on the mangrove resources of Fiji. School of Australian Environmental Studies, Griffith Univ.

Barclay, Glen, 1978. A history of the Pacific from the Stone Age to the present day. Sidgwick and Jackson, London.

Belcher, W. J., 1972. Birds of Fiji in Colour. Collins, Auckland.

Dahl, Arthur L., 1976. Regional ecosystems survey of the South Pacific area. SPC and IUCN, Second Regional Symposium on the Conservation of Nature, Apia.

Delacour, Jean, 1966. Guide des oiseaux de la Nouvelle Caledonie et ses dependances. Delachaux et Niestlè, Neuchatel.

Douglas, Gina. 1969. Check list of Pacific Oceanic Islands. Micronesica 5 (2).

Elton, Charles S., 1958. Ecology of invasions by animals and plants. Chapman and Hall, London.

FAO ACHRR, 1978. Mammals in the seas. Vol. 1. FAO, Rome.

IUCN, 1978. First draft of a World Conservation Strategy. IUCN, Morges.

Johannes, R. E., 1978. Traditional marine conservation methods in Oceanic and their demise. Ann. Rev. Ecol. & Systematics.

Keast, Allen, 1966. Australia and the Pacific Islands. Chanticleer, Random House, New York.

King, Warren, 1973. Conservation status of birds of Central Pacific Islands. Wilson Bulletin 85; 89-103.

Knox, Margaret, 1978. The green book of Fiji. National Trust, Suva.

Pritchard, P. C. H., 1977. Marine turtles of Micronesia: survival, status and recommendations. 55 pp mimeo. IUCN/WWF.

Salvat, Bernard, 1977. The living marine resources of the South Pacific - past, present and future. 23 pp. mimeo. Paris.

SPC and SPEC, 1977. Comprehensive environmental management plan. SPC, Noumeau.

Stoddart, D. R. and P. F. Gibbs, 1975. Almost atoll of Aitutaki. Reef studies in the Cook Islands, South Pacific. Atoll Research Bull. 190.

Udvardy, Miklos, 1975. World biogeographical provinces. CoEvolution Quarterly, Sausalito.

Wood, A. H., 1932. History and geography of Tonga. Canberra Pub.

Woods, Gay, ed., 1978. South Pacific dossier. Australian Council for Overseas Aid, Canberra.